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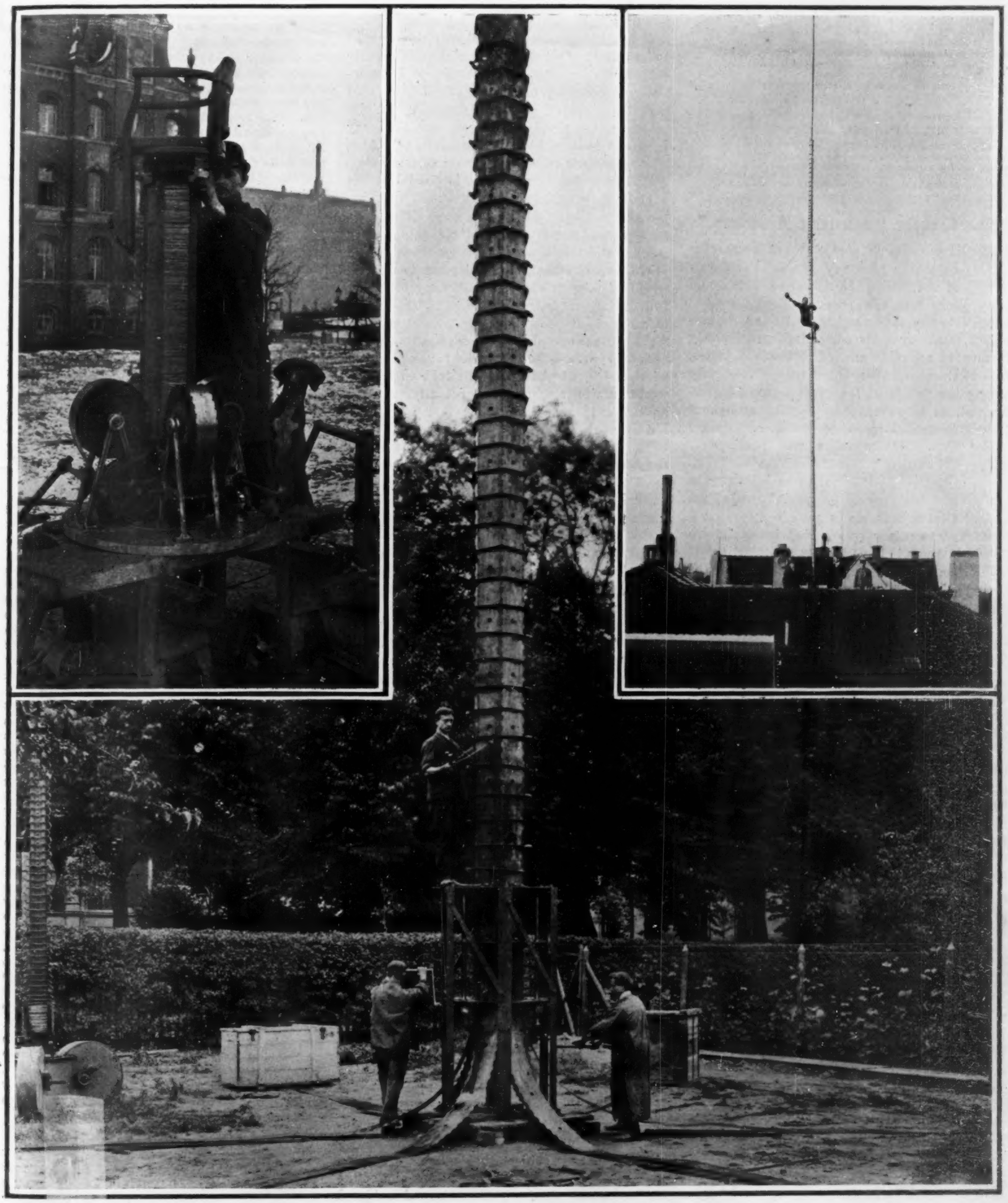

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SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, DECEMBER 31st, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The Greater "Scientific American."

THE opening of another year marks the beginning of a new era in the history of the "Scientific American." Six and sixty years ago this paper made its modest entry into the then very limited field of journalism, and, by addressing itself particularly to men of scientific and of mechanical tastes, became the pioneer journal of its kind, not only among the people of the great western republic, but, as the event has proved, throughout the whole English-speaking world.

The choice of its name was particularly happy. Forethought and good fortune combined in its selection; for the new venture was made in that transition period when the United States, hitherto a purely agricultural country, was entering upon that industrial era in which it was to win so noble a distinction.

For there was something in the blood of the average American that urged him strongly to the mechanical arts, and endowed him with a natural aptitude for science. A certain native curiosity and alertness, combined with a resourceful ingenuity begotten of two centuries of struggle with the primal forces of nature, had produced in the typical American a man for whom scientific knowledge and the practical arts possessed an inevitable attraction.

Appropriate, then, was the name and opportune the appearance of the "Scientific American," and its appeal was immediate. In an age when locomotives and steamboats were multiplying upon land and sea; when the telegraph was enmeshing the earth with its wires; when the primitive instruments of husbandry were being replaced by mechanical tools of greatly enlarged capacity; when machinery of rare ingenuity was doubling the output of loom and mill and shop; when science was unfolding its store of secrets so strange that each day wondered what the next would bring forth—in such an age there was a demand for some medium which should chronicle these achievements, and tell of them in language which the average man could understand. Hence the name; hence the mission; and herein the immediate appeal and ever-growing popularity of the "Scientific American."

For several decades this journal stood practically alone in the particular field which it covered. Launched in a new country, destitute of great libraries, great museums, or great universities, it served in a limited degree, it may be, but with distinct success, the purposes of all three. Not a few of the men who stand at the head of the great industrial institutions of the United States, will recall, as they read these lines, the days of their buoyant, eager, American young manhood, when their chief source of instruction in the great happenings of that world in which they were about to make venture was the "Scientific American."

The purpose of this journal has been to record accurately, succinctly, and in simple language, the story of the world's progress in scientific knowledge and practical achievement, omitting no event that has aided materially in this progress. In following out a program so ambitious, the "Scientific American" seeks to give such information on every subject of importance that comes within its scope, as to render it intelligible and instructive, and invest it with its due proportion of interest.

It has been the constant aim of this journal to impress the fact that science is not inherently dull, heavy, or abstruse, but that it is essentially fascinating, understandable and full of undeniable charm. The fundamental principles of science are simple—so simple that they may be stated in good Anglo-Saxon terms. Also, when science is embodied in mechanical devices and engineering structures it is possible to so explain these by drawing, photograph, and simple description, that they become intelligible and full of interest alike to the highly trained student and the layman.

We repeat that the achievements of the world of science, discovery, and invention are full of intense dramatic interest. The return of a comet—the magic of the X-ray—the swift flight of an aeroplane—the rush of a mile-a-minute express—the mysterious voice of the wireless—all of these may be told to a busy world in words that will arrest attention and answer a thousand questions that spring unbidden to the lips.

The "Scientific American" has grown with the age. From time to time it has been enlarged to take in an ever-widening field; but so swift has been the march of science and art, that it has now become necessary to make a further increase in the size of the paper, recast its make-up and typography, and include certain new features which the changing conditions of the times demand. These improvements involve no radical departure from a policy which sixty-six years of successful publication have indorsed. The changes will be in the direction of popularizing the magazine, without in any degre lowering its standard of accuracy and authority.

In presenting the first issue of the greater "Scientific American," dated January 7th, we draw attention to the fact that the paper has been increased to twenty-four pages. Once a month there will be a mid-monthly number of increased size, in which the regular pages will be devoted, as usual, to current news, and the large additional space will be given over to the discussion of some special topic of live, current interest. This mid-monthly issue will be inclosed in a colored cover; and in spite of the greater size and cost of all the issues, they will be sold, for the time being at least, at the same price as the present paper.

A new feature will be the inclusion of a larger number of signed articles, written by men of special knowledge and world-wide reputation in the particular fields of which they write; and the "human interest," about which we hear so much to-day, will be strengthened by the publication of portraits and biographies of famous living men who are doing the big things in science, engineering, and the arts.

The greater "Scientific American" will maintain an absolutely impartial and independent attitude on every subject that enters its reading columns, and it will be the constant aim of the editors to emphasize that policy of unbiased criticism which is the foundation stone of the true editorial authority.

RETROSPECT OF THE YEAR 1910.

Civil Engineering.

In any retrospect of the engineering work of the past year, the Panama Canal necessarily looms largest in the minds of all Americans. This great undertaking has made most satisfactory progress. The hydraulic fill of the Gatun Dam has reached an elevation of about 70 feet above mean tide; the spillway has been cut through and concreted; the excavation for the adjoining locks is nearly done; and one-quarter of the total two million yards of concrete required in the locks has been built into place. The contract for all the huge lock gates for the whole canal has been let, and the successful bidders will have them completed by June 1st, 1913. In spite of heavy slides, the Culebra Cut will be finished approximately at the same time as the locks, and, judging from present conditions, the canal will be practically finished fully twelve months before the date, January 1st, 1915, originally set for completion by the army engineers who have charge of the work. Col. Goethals, his staff, and the great body of workmen at the Isthmus are to be congratulated on their successful mastery of this once seemingly hopeless task. Second only in importance to the foregoing work is the construction of the New York State Barge Canal, whose total length as completed will be 442 miles. It extends from the Hudson River at elevation 125 above sea level to Tonawanda, near Buffalo, on Lake Erie, where the final stretch of the canal is at elevation 565.6. The masonry structures alone will require 4,250,000 cubic yards of concrete; and 113,000,000 cubic yards of earth and silt, and 11,000,000 cubic yards of rock will have been excavated by the time the canal is completed. At the present time, nearly the whole of the work is under contract, and from now on progress will be greatly accelerated. Another vast enterprise designed to improve the waterways of the United States is the scheme known as the Atlantic Coast Canal, which, as contemplated by act of Congress, is designed to provide an inland waterway, parallel and adjacent to the Atlantic Coast, over the whole distance from Boston, Mass., to Key West, Fla., and thence by way of the Gulf of Mexico to New Orleans. Col. Black, of the Corps of Engineers, has recently presented a report upon that section of the canal extending from New York to Philadelphia, which pronounces the plan to be feasible. The estimate of the time of transit between New York and Philadelphia through a sea level canal costing under forty million dollars, would be about seven hours. Steady progress has been made on the Cape Cod Canal, which is designed to provide a deep waterway about four miles in length through the neck of Cape Cod, and thus afford an unbroken inland waterway from New York to Boston, by which ships can avoid the stormy ocean trip around Cape Cod and save several hours in the time of transit. The most notable canal project in Europe, that has received public and official attention, is the Firth of Forth Canal, which will open a waterway for the largest ships across Scotland from the Firth of Forth to the Firth of Clyde. It is estimated that the work can be completed in nine years at a cost of one hundred million dollars. The great project for bringing a daily supply of five hundred million gallons of water from the Catskills to New York city is being pushed through by the contractors with such activity that the great Ashokan Dam is nearing completion, and the prospects of delivering the first instalment of water to the present Croton Dam within four or five years' time are very encouraging. The city government has recently authorized the construction of a remarkable deep tunnel aqueduct, 11 to 16½ feet in diameter, for distributing the Catskill supply, which will extend at a depth of 100 feet or more from Yonkers beneath the full length of Manhattan Island, a distance of nearly twenty miles. At intervals shafts will communicate with the surface mains of the city. This work will be altogether without precedent in the history of municipal water supply. A notable event of the year was the completion of the four-mile tunnel through the Andes on the Transandine Railway between Chile and Argentine. The Cape-to-Cairo Railway has made steady progress and now extends north from the Cape over a continuous distance of nearly 2,500 miles. A notable event of the closing days of the year was the offer of the Interborough Company to build such elaborate extensions of the present elevated system and of the Subway (the first to be finished within two years, and the second within five years' time) as to completely double the existing rapid transit facilities in New York City.

Aviation.

The extraordinary progress in the mastery of the art of flying which characterized the year 1909 has been even more marked in 1910, the achievements in altitude, speed and distance, to say nothing of cross-country flying, having exceeded the most sanguine expectations of the enthusiast. The story is best told

in the following necessarily brief enumeration of the principal achievements. Taking flights of altitude first, as being the most spectacular, we find that on January 7th, Latham in an Antoinette monoplane soared to an altitude of 3,280 feet. This was in France. Three days later, his countryman, Paulhan, at the Los Angeles meet, astonished the world with an altitude flight of 4,165 feet. This stood for half a year, until, on July 9th, Brookins in a Wright biplane first passed the 6,000-foot mark, with a record of 6,171. Next was a jump of nearly 2,000 feet, when Morane in a Blériot monoplane, on September 3rd in France, reached 8,471 feet. Wynmalen in a Farman biplane was the first to exceed the 9,000-foot limit with an altitude of 9,104 feet. The ill-fated Johnstone, in a Wright biplane, lifted the record at Belmont Park to 9,714 feet; Drexel, another American, in a Blériot monoplane, rose to 9,897 feet at Baltimore; and on December 9th, Legagneux, in the wonderful Blériot monoplane, flying in France, reached and passed the ten thousand mark with a record of 10,499 feet. Finally, on December 26th, at Los Angeles, Hoxsey, in a Wright biplane, reached the great height of 11,474 feet, restoring the record to America. Last year, the speed of the aeroplane was slightly under 50 miles an hour; this year at Rheims, Morane, in his Blériot monoplane, made a new speed record over a 5-kilometer (3.1-mile) course of more than 66 miles an hour. This advance has been gained by constructing the aeroplane in strict accordance with the dynamics of flight, the motive power being greatly increased, and the wing surface reduced. In the Bennett Cup race Leblanc's fastest lap was made at 71.68 miles an hour, while he averaged 67 miles an hour for 19 out of the 20 laps. Grahame-White won with an average speed of 61 miles an hour. The first notable long-distance record of the year was made at the Rheims meet, when Olieslagers, in a Blériot, covered 244 miles in a closed circuit at an average speed of 48.31 miles per hour. This was completely outdistanced in the closing days of December by Legagneux, holder of the altitude record, who covered 320 miles over a closed circuit at an average speed of 53¼ miles an hour—a truly magnificent performance. A feature of the year has been the munificent prizes offered to stimulate cross-country flying. The first great achievement of this character was the winning by Paulhan in a Farman biplane of the prize of $50,000 offered by the London Daily Mail for a flight from London to Manchester, a feat which was accomplished on April 27th and 28th. This was followed in June by the daring flight of Curtiss in a 50-horse-power biplane of his make from Albany down the valley of the Hudson River to New York, by which he won a prize of $10,000 offered by the New York World. By this flight, also, Curtiss established for the third year a claim upon the Scientific American trophy. On June 13th Charles K. Hamilton made a daring flight from New York to Philadelphia and back on the same day, starting from and returning to Governor's Island, the distance of the round trip being about 175 miles. The success of these flights induced the New York Times to offer a $25,000 prize for a flight from Chicago to New York, and the New York World offered another prize of $30,000 for a flight from St. Louis to New York. An abortive attempt was made by Ely to capture the first prize, and no competition has taken place for the second. Great as has been the progress in aviation, such tasks as these are at present beyond the ability of the airman or his machine. Later in the year occurred the great 485-mile cross-country race in France, which was completed by three of the eight machines entered. The race was made in six stages on six appointed days, on each of which the contestants made the start regardless of weather conditions, which were exceedingly trying. Leblanc in a Blériot won, at an average speed of 40.71 miles per hour, which, in view of the conditions, must be regarded as perhaps the most practical feat of flying of the year. In view of the fact that he carried a passenger, the feat of the young American, Moisant, in flying from Paris to London, is certainly equally creditable. From Paris to Amiens was covered in two hours; Amiens to Calais, in two hours and six minutes, and the crossing from Calais to England was made in 37 minutes. An accident 30 miles from London, however, so delayed the aviator that he took nearly three weeks to cover the whole distance. Machines have flown from Paris to the German frontier and back regardless of weather, the distance being nearly five hundred miles, and the journey from Paris to Brussels (180 miles) and back, has been successfully made with a passenger. Among the feats of daring must be mentioned the ill-fated flight of Chavez across the Alps, at the conclusion of which, when within 30 feet of the ground, he lost control of his machine and was fatally injured. The possibilities of the aeroplane for touring purposes are shown in the many remarkable flights that have been made with passengers, Farman in his biplane having carried two passengers on a 62-minute flight, and Kinet having carried one passenger on a flight that lasted two hours and twenty minutes. Sommer, in a Sommer biplane, took three passengers aloft for a five-minute flight, and a biplane later succeeded in making a short flight with no less than six people on board. The above are but a few of the remarkable performances of the year. As for the machines themselves, it can be said that there have been no radical changes, both the monoplanes and the biplanes retaining their characteristic features. The excellent fore-and-aft stability of monoplanes, largely due to their rear elevating rudders, has led the builders of biplanes to adopt the same arrangement, and always with beneficial results. Wing-warping seems destined to become the universal method of lateral control, which is a distinct tribute to the genius of the Wright brothers, who used it on their original machine. Ailerons are also used for lateral stability on several of the leading machines, but not to the same extent as warping. Among motors, the revolving Gnome seems to stand supreme, a position which it holds by virtue, first of its great reliability, and second of its light weight for its power. One great lesson of the year is the need for the employment of a larger factor of safety in all aeroplane construction, the majority of fatal accidents having been due to collapse of the machines while in the air. The stopping of the motors, also, has been a frequent cause of disaster; and with a view to preventing such and giving the machine greater durability and all-around safety, Mr. Edwin Gould has offered through the Scientific American a prize of $15,000 for the best machine equipped with more than one motor.

Although the development of the dirigible balloon is not comparable with that which has marked the aeroplane, some very remarkable flights have been made. The "Zeppelin II," or "Deutschland," carrying 13 passengers, made a passage from Friedrichshafen to Duesseldorf in nine hours at the rate of 33 1-3 miles per hour, a truly epoch-making performance. This occurred on June 22nd, and on June 24th, in a 100-mile circular trip from Duesseldorf, 32 people were carried. Two weeks later this magnificent vessel, so full of promise of future performance, was caught in a storm, during which she dropped into a forest and was destroyed. Earlier in the year, the "Zeppelin II.," "Gross II.," and "Parseval I." flew from Cologne to Hambourg, where they were reviewed by the Emperor. A gale arose, but the three ships weathered it, moored in the open. "Gross II." was deflated and shipped back by rail, the "Parseval" alone succeeding in making the return voyage. The "Zeppelin," after descending at Limberg, broke away in the strong wind and was finally broken in two against the side of a hill at Weilburg. In spite of these many disasters, the Germans maintain their faith in the future of the dirigible. A most successful dirigible flight of the year was that of the Clement-Bayard British dirigible, which flew, without a stop, from Paris to Aldershot in a little over six hours' time.

Astronomy.

First among the astronomical discoveries of the year was that of a comet reported from South Africa on the 17th of January, so bright that it was visible in full daylight to the unaided eye.

Other minor comets of interest which deserve to be mentioned were Metcalf's, discovered in August, and Cerulli's discovered in November, and later identified as the return of a well-known old one, Faye's comet, which has been regularly observed at its returns every seven and one-half years since 1843, except in 1903, when it was unusually far from the earth and on the other side of the sun.

Brooks's periodic comet was discovered on its return by Aitkin and Wilson at the Lick Observatory on October 1st. This body has now been observed at four returns and its period is accurately known. Although a rather faint object, it proves of considerable theoretic interest, for Bauschinger, who has made a careful investigation of its orbit, finds that its period seems to be shortened slightly. This may mean that like Encke's famous comet, it meets with some resistance in its motion through space.

The most interesting cometary event was of course the return of Halley's historic wanderer after an absence of 75 years. Although it was by no means the spectacular phenomenon that we had expected, the comet served the useful purpose of adding a little to our store of cometary knowledge.

On May 19th the earth was partially immersed in the tail of Halley's comet while the head was only fifteen million miles away. The feature of this close approach to the earth was undoubtedly the curvature of the comet's tail, which caused it to lag so far behind the prolongation of the line joining the sun and comet that it did not graze the earth until more than thirty-six hours after the expected time.

Transits of comets across the sun are very rare. Hence the transit of Halley's comet was an occasion of moment. The most remarkable previous instance is that of the comet of 1882, which was so bright that it could be seen close to the sun in broad daylight by the naked eye, but which, when near the sun, disappeared, showing that it was practically transparent. Halley's comet could not be detected as it crossed the sun's disk, and thus repeated the experience of 1882.

The tail losses which were so characteristic of Morehouse's comet were repeated in the case of Halley's body. The exact rate at which sections of the tail were driven away from the main body out into space could be calculated from photographs. Indeed, the tail of Halley's comet conducted itself in a most whimsical fashion. It fluctuated in length and at one time split longitudinally into several more or less well defined parts, and repeated, to a certain extent, the phenomena of Morehouse's comet of 1908.

Spectroscopically Halley's comet presented the usual phenomena.

Parallax investigations on thirty-five selective stars were published in the second volume of the Transactions of the Astronomical Observatory of Yale University. The grand result of the work at Yale, which has occupied three observers for some years, is to assign a parallax to two hundred stars with an accuracy which has not been exceeded elsewhere.

It should also be recorded that the discovery of three new stars within a few weeks of one another was reported from Harvard. Two were found by Mrs. Fleming (who now has ten such discoveries to her credit) on plates taken at Arequipa, Peru. Of these, the first, in Sagittarius, must have appeared in the early part of 1910; the second, in the far southern constellation Ara, was much brighter. Both stars showed the characteristic bright-line spectrum, and it is probable that, as in other cases, their sudden flashing out may be attributed to collision of a faint star with a nebula or a cloud of meteorites. The third new star was found by Miss A. J. Cannon on a photographic plate of the constellation Sagittarius made on August 10th, 1899.

The members of the International Union for co-operation in studying research met at Mount Wilson. The meeting proved unique and memorable. It may be questioned whether there ever were assembled so many eminent astronomers and astrophysicists at one time.

The year 1910 exhibited a series of four eclipses, two of the sun and two of the moon. A total eclipse of the sun occurred on May 8th; a total eclipse of the moon on May 23rd; a partial eclipse of the sun on November 1st; and a total eclipse of the moon on November 16th. The eclipses were astronomically not out of the ordinary.

Radioactivity.

Madame Curie and M. Debierne succeeded in preparing metallic radium after a method suggested by Gunz for the production of metallic barium, which method consists in preparing an amalgam and in expelling the mercury by distillation under suitable conditions. Metallic radium alters very rapidly on contact with the air, a nitrogen compound being formed.

The need of a definite radium standard in which all results should be expressed, has been growing more and more acute. Scientific results are now expressed in many cases in terms of arbitrary radium standards kept in each laboratory, and it has been difficult to be certain of the accuracy of relative value of such standards. At the instance of Prof. Rutherford, a special committee was appointed at the International Congress of Radiology and Electricity held at Brussels, to fix an international radium standard.

A sensation was created three years ago by Sir William Ramsay's experiments on the action of radium emanation upon copper. Ramsay claimed that this emanation caused a disintegration of the atom of copper and converted that metal into small atomical portions which are included in the copper group of Mendeleef's classification. Ramsay claimed to have found, among the products of emanation copper, potassium, sodium and lithium. Madame Curie repeated Ramsay's experiments, but obtained negative results. Ramsay then took up the work again, taking care to eliminate possible sources of error to which Madame Curie had called attention, and confirmed his previous results. He also conducted a new series of experiments, which, if correctly interpreted, prove that elements of the disaggregated carbon group are affected by the action of the emanation.

Naval and Military.

The interest of the year in naval matters has centered in the question of the relative strength of the powers in ships of the dreadnought class. Rightly or wrongly, it has come to be accepted as a truism that the naval power which is strongest in vessels of this class, no matter what its strength may be in warships of the pre-dreadnought era, must necessarily be the leading naval power. Hence, it has come to be the fashion to speak of the dreadnought as a revolutionary type, which has almost wiped out the existing fleets

(Continued on page 518.)

NEW AEROPLANE DURATION AND DISTANCE RECORDS

SOME OF THE RECORD BREAKING FLIGHTS ACCOMPLISHED BEFORE THE END OF THE YEAR

After having made thorough preparation for a world-breaking duration flight, M. Henry Farman, on December 18th, remained aloft 8 hours and 23 minutes in his new biplane and succeeded in breaking by 2 hours and 22 minutes the existing record of M. Tabuteau, accomplished on a Maurice Farman biplane of similar construction. M. Tabuteau's record was made on October 28th at Buc, France. On this occasion he covered 465.72 kilometers (289.38 miles) in 6 hours and 1 minute—an average speed of 48.06 miles an hour. His biplane was propelled by an 8-cylinder, air-cooled Renault motor of 50 horse-power. He created a new record for duration and distance, but not for speed, as the speed record in a long-distance flight is held by the Belgian Jan Olieslaegers with a Blériot monoplane. Last July at Rheims, Olieslaegers remained aloft 5 hours and 3 minutes, and covered 244 miles at the rate of 48.31 miles an hour. His record, as well as the new one of Henry Farman, was made with a 50 horse-power Gnome revolving-cylinder motor. The performance of the Renault air-cooled motor on M. Tabuteau's machine shows that revolving cylinders are not essential to a good air-cooled motor. The performance of the motor was all the more noteworthy in view of the fact that it was located behind the aviator, who had a large wind shield (similar to that used by Farman) in front of him.

For the past three years Henry Farman has been constantly engaged in developing and perfecting a biplane type of aeroplane. At one time last summer he constructed a monoplane (which was illustrated in our columns at the time); but most of his efforts have been given to the developing of a slow-speed machine capable of carrying a great weight. Farman's first great success occurred on January 13th, 1908, when he won the Deutsch-Archdeacon prize of $10,000 for making the first kilometer in a closed circuit. On December 31st, 1908, Wilbur Wright won for the first time the Michelin prize of $4,000 (which is given annually for eight years to the aviator who covers the longest distance in a closed circuit each year) by his flight of 123.2 kilometers (76½ miles) at Auvours, France. On November 3rd, 1909, Henry Farman succeeded in raising this distance to 232 kilometers (144 miles), which he covered in 4:06:26 at the rate of 35.06 miles per hour.

M. Farman made his flight on December 18th last with the express purpose of winning the Michelin trophy for this year. His machine was provided with a searchlight and he flew for three-quarters of an hour after darkness had set in. He was deceived by the cheering of the spectators, and, believing that he had broken the record, he descended only to find that he had covered but 463.6 kilometers as against Tabuteau's 465.72, and this notwithstanding the fact that he had remained aloft over two and one-third hours longer than his rival. His average speed was 34.34 miles an hour, as against 48.06 miles an hour of his competitor. It is probable that he will make another attempt to win the trophy before the end of this year.

Some facts regarding M. Farman's machine, which we illustrate herewith, will no doubt be of interest to our readers. The new biplane has a total spread of 15 meters (49.2 feet). The upper plane extends out five or six feet beyond the lower plane at each end—an arrangement which Farman has used ever since Paulhan's flight from London to Manchester early in the year. The boat-shaped bow and wind shield fitted on this machine is the invention of M. Farman's brother Maurice, who has used a similar prow on most of his biplanes. In the detail view of this prow the trussed operating lever that works the horizontal rudder in front is seen beside the prow just below M. Farman's face. The huge gasoline tank, having a capacity of 280 liters (74 gallons) is seen just back of the aviator. The Gnome motor is located back of this tank at the rear edge of the lower plane. Each wing of the lower plane is set at a slight dihedral angle to the center portion, and is braced by inclined struts running from its outer end to the center of the extension on each end of the upper plane. The hinged flaps or ailerons for the purpose of balancing the machine transversely, can be seen hanging down from the rear edge of the extensions of the upper plane. One at each end is all that is required, where the upper plane is made longer than the lower one, as in this case. The rear part of the upper surface of the tail is hinged and made to move in conjunction with the front horizontal rudder, as heretofore; but a novelty consists in the fitting of a third vertical rudder in the center and just ahead of the forward edge of the tail. The two vertical rudders between the tail surfaces at the rear are also used. The machine is mounted upon two long skids hung by heavy elastic bands from the axles of the two pairs of wheels seen in the front view photograph. A skid is all that is required beneath the tail.

The lifting capacity of this machine is so great that it can carry sufficient fuel for a 12 hours' continuous flight. The weight of the fuel alone is nearly 450 pounds.

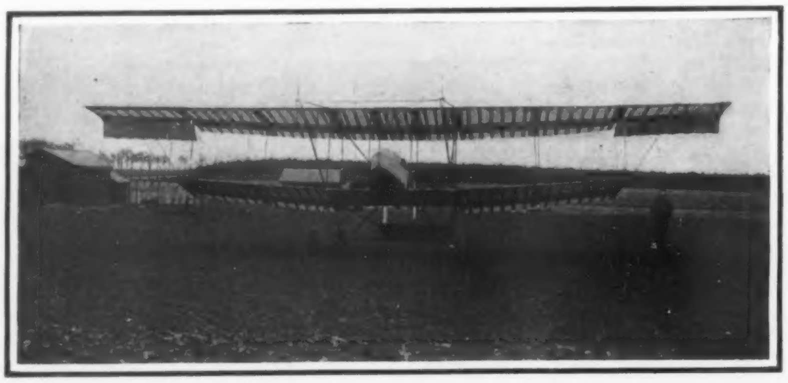
It is interesting to note that M. Farman's great duration flight was made within one day of seven years from the time the Wright brothers made their first flight with a motor—December 19th, 1903. M. Farman has shown the possibilities in the line of weight carrying and endurance, and by the use of more powerful motors, greater speed can be obtained. An up-to-date monoplane or biplane has a touring radius of 350 miles at the present time, and it will not be long before one can make a 500-hundred-mile trip in an aeroplane without coming to earth. That we are justified in making this statement is proven by M. Legagneux's performance on December 21st, when he raised the distance for the Michelin trophy to 320.62 miles (516 kilometers) in 6 hours and 1 minute with a Blériot monoplane. In exactly the same time of flight as Tabuteau, he covered 31¼ more miles. His average speed was 53¼ miles an hour.

On December 21st, also, Mlle. Helene Dutrieu made a new record for the Coupe Femina of 167 kilometers (103¾ miles) in 2 hours and 35 minutes. Mlle. Dutrieu's only competitor was Mlle. Marvingt, who made a record of 45 kilometers (28 miles) in 53 minutes, the 27th ultimo, on her Antoinette monoplane, only to have this beaten a few days later by Mlle. Dutrieu's flight of 1 hour and 9 minutes. The latter aviatress won her pilot's license last August and soon after carried a passenger from Ostend to Bruges and back—28 miles—in record time.

On December 18th, also, Grahame-White smashed his new British-built biplane while making a trial flight at Dover in a strong wind. The machine rocked badly and finally crashed to earth from a height of 75 feet. He and seven other aviators had been waiting a fortnight for good weather in which to compete for the De Forest prize of $20,000 for the longest flight by an Englishman on a British-built machine across the Channel and into Belgium. Mr. Thomas Sopwith, another English aviator who holds the British long-distance record, set out at 8:15 A. M. the same day from Eastchurch, on the Isle of Sheppy, crossed the Channel and landed at Beaumont, Belgium, 3½ hours later, having covered a total distance of 174 miles at nearly 50 miles per hour. He used a Howard Wright biplane, fitted with an 8-cylinder E. N. V. motor of 50 horse-power. There were several other machines of the same make entered, and on December 22nd Cecil Grace, another well-known English aviator, flew across the Channel on another of them and went as far as the Belgian frontier. He turned back because of adverse winds, and landed at Les Baraques, near Calais, at 10:45 A. M. At 2:10 P. M. he set out on the return trip, traveling in a northeasterly direction. He did not reach England in safety, and it is feared that he met with an accident and was lost. The same day Lieut. Camerman, a French army officer, won the L. Weiller prize by flying across country with a passenger and covering 147 miles in 4 hours and 2 minutes. The best previous record was that of Weyman, who covered 136.62 miles on September 7th last in a flight from Paris to the Puy de Dome for the Michelin trophy.

Mlle. Dutrieu, the winner of the Coupe Femina.

Mlle. Dutrieu flew 103¾ miles on December 21st in 2 hours and 35 minutes in her Farman biplane. Her average speed was 40.16 miles an hour.



Front view of Henry Farman new biplane with which he broke the endurance record.

The lower plane is 12 to 14 feet shorter than the upper one, the total spread of which is 49¼ feet. Ailerons are attached to the upper plane only. Three vertical rudders are used at the rear.

Henry Farman in his new biplane. He made a world's endurance record of 8 hours and 23 minutes on December 18th, covering 288.06 miles.

The huge gasoline tank holding 75 gallons is seen behind M. Farman, who carried a small provision chest from which he refreshed himself while flying.

NEW AEROPLANE DURATION AND DISTANCE RECORDS.

WORK ON ST. MARTIN CANAL, PARIS

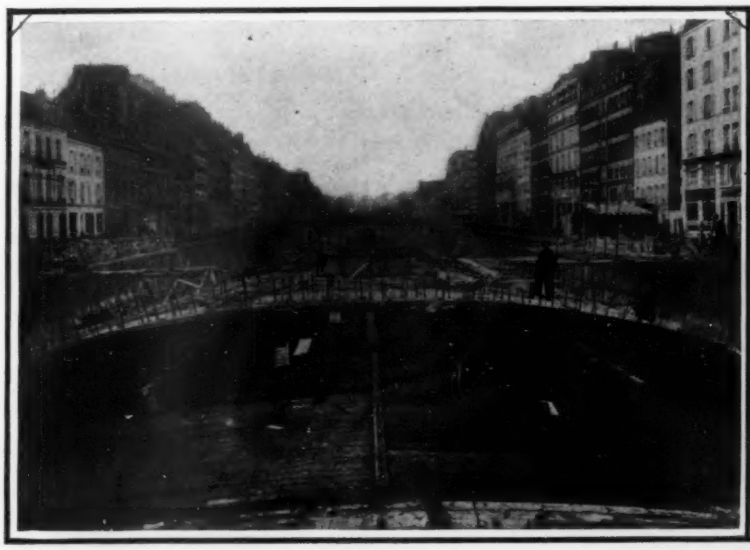
BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN

In France the use of reinforced concrete has much increased within the last few years, owing to the fact that its advantages are becoming recognized for many different kinds of construction. We illustrate a piece of work which was carried out at Paris not long since, and it lies somewhat out of the usual order. Paris has several canals running across it, and they form part of the extensive system of canals which serve to connect the Seine with other streams in the region. There is a regular canal-boat service on these lines which handles a considerable amount of freight. Lying next the Seine is the St. Martin canal and upon a part of its length it was already covered over so that it ran in an underground passage under one of the wide boulevards. Upon this portion there was used a masonry arched construction upon which the middle part of the boulevard was laid so that the canal was concealed from view. Of late it was desired to extend this covering, seeing that the property owners in the other part of the boulevard objected to having the canal pass along the middle part, as this made the property less valuable in this quarter. Hence it was decided to extend the vaulting for a distance of 802 feet, and the city engineering department pronounced in favor of reinforced concrete for this purpose, the contract being awarded after a competitive test to M. Boussiron, a well-known constructor. The total width of the canal which is covered by the vaulting is 53 feet at water level, not including the towpath at each side of the canal. For towing the boats, however, steam tugs are generally employed at present.

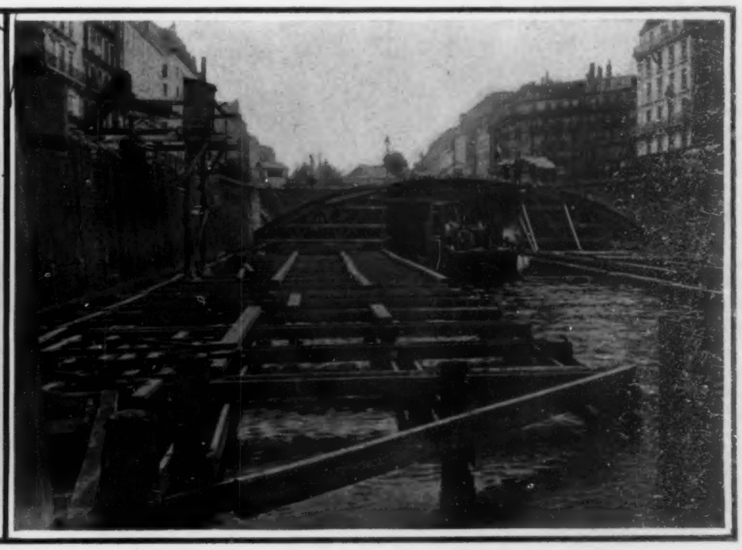
View of St. Martin canal with vault completed.

An advantage gained by the reinforced concrete is that it has less thickness in the arched part, so that we obtain a greater available height for the tunnel, and given the height of the canal boats, we have a greater width for the canal which can be used by the boats. In this way the previous objection to the tunnel that the boats could not properly pass and make the needed shifting operations, could not be upheld, and in fact it was on account of a recent study of the advantages of reinforced concrete that the engineering department decided to carry out the roofing over this part of the canal, otherwise the problems would not have been solved so soon. This now allowed of laying out the Boulevard Richard Lenoir about as was done for the first part, and it has the appearance of a boulevard planted with two ranges of trees in the middle space, allowing for the roadway on either side. Here, however, the middle space is laid out with turf and gardens, the whole being supported upon the vaulted construction. There are left two circular openings of 10 feet diameter in order to light the underground passage.

The span of the vault is 86 feet. One feature to be noted in the present construction is the use of what is known as the "semi-articulation" system or elastic joint, and in this way the arch is not rigid, but has a

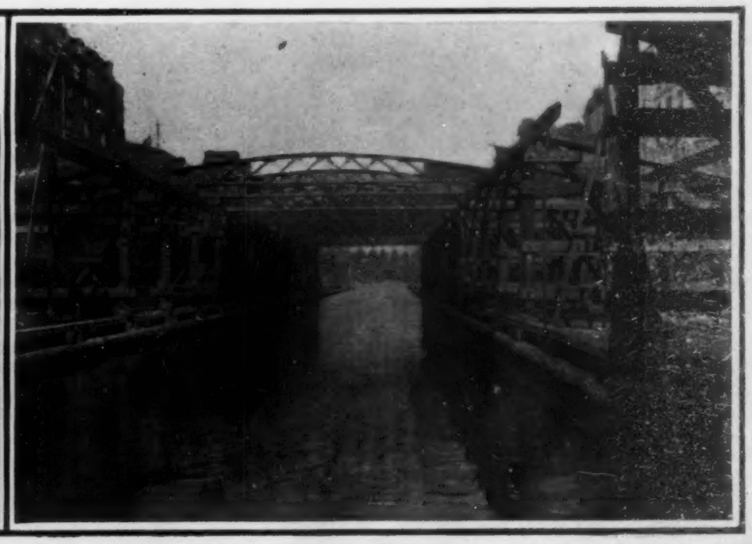


Showing reinforced concrete work.



Method of vaulting a distance of 802 feet.

View of detail construction.



Preparatory work.

WORK ON THE ST. MARTIN CANAL, PARIS.

certain yield. The vault rests upon an embankment running along the tow-path wall, but as this could not be made very thick, we must depend in part upon the resistance of the earth in the rear of the wall. Owing to the loose character of this earth, with its sewers and gas pipes, slight movements are likely to occur which would break a rigid vault. Owing to the yield of the new vaulting, however, there will be no danger from this cause.

Experiments with this type of concrete vaulting were made during the last few years at the laboratory of the Paris School of Bridges and Highways, which is one of the government institutions by Chief Engineer Mesnager, and he has already exposed the advantages of this method in detail. The essential feature of the elastic system is that it has three semi-flexible joints, one at the key of the arch and one at each base. The arch as a whole is made up of iron rods bent into shape and properly cross-braced, this web being filled around with concrete as usual. Such would make a stiff and unyielding arch, were it not for the fact that at the joint the iron is left bare, or nearly so, and thus we obtain the flexibility due to the iron at this point, and can have a slight bending. The ironwork at the joint needs to be strengthened by adding a number of extra bars here, but these are short, as they are only needed at the joint itself. At the joint, therefore, there is but little concrete and a greater amount of iron. Such extra bars are of round iron, about 1 inch in diameter. It was found desirable to brace the vaulting by adding stiffening ribs at stated intervals along the whole stretch of the canal length, and these ribs are spaced 3 feet 7 inches apart. They form a regular part of the reinforced concrete work. The thickness of the concrete vaulting is always less than 18 inches, while the ribs are of variable height.

One of our views shows the method adopted for building the vault so as to allow the canal boats to pass at the same time. A timber construction was built upon piles at each side, leaving the middle space free for the boats. Several flat arches of structural iron were built which served as forms for laying the reinforced concrete work, and, the iron forms could be rolled along upon a timber way at each side so as to be used in various places. After building the concrete vault upon one of the forms, the latter was lowered for an inch or so and then run along so as to come into a new position, so that the work could be carried out progressively and without any trouble. The forms themselves were made of iron arches spaced 8 feet apart and covered with a plank flooring, this being properly shaped for the profile of the concrete vaulting, and oiled so as to prevent the concrete from adhering.

No harm was done to the present vaulting by the recent inundations of the Seine, which speaks greatly in its favor. The present method is likely to come into more extensive use, seeing that its advantages are now recognized. Using a rigid vault, a very small movement of the abutments would cause much damage from cracking, so that all calculations are reduced to naught, while this is not to be feared with the present system, and a close calculation can be made for the arch. On the other hand, the construction is economical, and the cost per square yard of surface lies much below the ordinary.

The Winnings of Aviators.

According to the Paris Figaro, the aviators named below won, in aviation meetings, prize contests, and special performances, between August, 1909, and the first of October, 1910, approximately the sums which are printed after their respective names: Louis Paulhan, $82,000; Hubert Latham, Morane, Rougier, $52,000; Chavez, $49,000; Grahame-White, $35,000; Alfred Leblanc, $33,000; Henry Farman, $23,000; Dickson, $17,000; Glenn Curtiss, $16,500; Comte de Lambert, $12,500; Hamilton, $10,000; Johnstone, $9,500; Louis Blériot, $8,400; J. de Lesseps, $2,700.

Eight aviators won more than $20,000 each; 21 won more than $10,000; 30 won more than $5,000; 54 won more than $2,000. Santos-Dumont won only $300, Delagrange $140, and Capt. Ferber $40. Among the "aviatresses" the Baronne de Laroche distinguished herself by winning the ladies' prize of $1,000 at Rheims. These sums do not include payments fixed by private contract at some meetings and exhibitions.

To Our Subscribers.

We are at the close of another year—the sixty-sixth of the Scientific American's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year. To those who are not familiar with the Supplement, a word may not be out of place. The Supplement contains articles too long for insertion in the Scientific American, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the Scientific American and the Supplement the subscriber receives the benefit of a reduction in the subscription price.

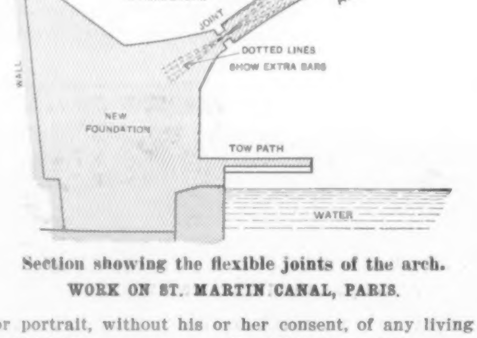
New Welsbach Patents.

From a commercial as well as a scientific standpoint, a number of patents issued on November 22nd, 1910, to the assignee of Carl Auer von Welsbach are regarded as of much importance. They relate to filaments for use in incandescent lamps, and the applications on which some of the patents issued were pending in the United States Patent Office since August 9th, 1898. The patents, or some of them, appear to be sufficiently broad to cover all commercial metallic filaments consisting of metallic particles fritted together, except platinum and other metals whose volatilizing point is equal to or lower than that of platinum.

Prints and Labels in the Patent Office.

The Attorney-General of the United States having decided that prints and labels may be registered by the Patent Office, many are now availing themselves of the opportunity, and numerous registrations are appearing in the weekly issue of the Official Gazette.

How or under the provisions of what law they should be so registered, has not been adjudicated by any court. The prints or labels to be registered must be artistic or intellectual productions, must be descriptive of the goods to which they refer, must have been published, and the notice of copyright should appear on the specimens submitted to the Patent Office. The words "Label Registered" should not appear upon the labels; the pure-food guarantee legend, if used, must appear in proper form, and the print or label should contain no misleading or deceptive statement. No public insignia, nor the name or portrait of a former President of the United States, nor the name or portrait, without his or her consent, of any living individual can appear on the label or print; nor can a label be registered which contains a trade mark as its only artistic feature.



Section showing the flexible joints of the arch.

WORK ON ST. MARTIN CANAL, PARIS.

The Current Supplement.

The leading feature of the current Supplement, No. 1826, is an article by Mme. Curie, on Radioactivity. The article is taken from the introduction to her forthcoming book.—Still another article of interest which deals with the subject of radium is a discussion of the need of an international radium standard. —In the last few months, there have come to light designs of four types of the most recent dreadnoughts, none of which has yet been launched. These four types are discussed by Capt. Barberis, of the Royal Italian Navy.—Dr. Alfred Gradenwitz writes on the use of electricity in gas works.—The railway shooting car of a native chief in India is described by F. C. Coleman.—Marine steam turbines of the Parsons type have now been in service for some years, so that it becomes possible to discuss the troubles to which they have shown themselves liable. This is done in an excellent critical article.—Alfred J. Henry tells how a Weather Bureau kite may be constructed.

Halley's Comet.

Prof. E. E. Barnard informs us that he has been observing Halley's comet at Yerkes Observatory in the morning skies. His first observation was made on November 11th. He has since observed it on December 11th and 13th. Despite its great distance, the comet is not very faint. It is about of the twelfth magnitude, and in Prof. Barnard's opinion ought to be visible in a comparatively small telescope. It is about one-quarter of a minute in diameter and is round in shape, with neither tail nor nucleus, although it displays a central brightness.

There are 47 firms of aeroplane builders in France and already 8 in Germany. During August alone in France, 45,000 kilometers were flown in races, and 25,000 across country.

RETROSPECT OF THE YEAR 1910.

(Continued from page 515.)

from serious consideration. The Scientific American has always questioned, and still does, the soundness of this view. The first shock of battle between the dreadnoughts will be so destructive that victor and vanquished alike will find their first line of battle terribly crippled; and it seems to us that the final issue of the struggle will lie with that nation which can bring up the strongest second line of battleships of the "Connecticut," "King Edward" and the "Deutschland" class. At the present writing, the rating of the great powers in dreadnoughts is as follows: Great Britain leads with 11 completed and 11 under construction; Germany, ranking second, has five completed and twelve under construction; she is followed by the United States, with four built and four in course of construction. France has no ships of the strictly dreadnought class in commission, and has but three under construction. Japan has built two, and has two in hand. Russia is building four dreadnoughts, but has none completed. Italy is in the same condition, while Austria is building two of this class. In battleships of the pre-dreadnought type, Great Britain leads with 49, followed by the United States with 25, Germany with 22, France with 17, Japan with 12, Russia with 8, Italy with 9, and Austria with 5 battleships. In the foregoing estimate of dreadnought strength we have included with the battleships all armored cruisers carrying exclusively a big gun armament. In armored cruisers of the pre-dreadnought period, Great Britain leads with 34, followed by the United States with 12, Germany with 9, France 21, Japan 11, Russia 7, Italy 10, and Austria 3. When the vessels now under construction are completed, the rank and tonnage of the navies will be as follows: Great Britain, 2,173,838 tons; Germany, 963,845 tons; United States, 824,152 tons; France, 725,231 tons; Japan, 493,671 tons; Russia, 401,463 tons; Italy, 327,059 tons, and Austria, 309,899 tons. The advance in size and power of battleships has been simply astounding, and no one ventures to state what will be the limit. The latest battleships building for this country, the "New York" and "Texas," are to be of 27,000 tons, mounting a new 14-inch gun. "The Lion," a British 28-knot armored cruiser, 660 feet in length, and carrying eight 13.5-inch guns, will be of 26,500 tons displacement, and a larger "Lion" is being planned of 28,000 tons, which is to be at least 700 feet in length, and of 30 knots speed. The Argentine ships, built in this country, are of 28,000 tons, and Armstrongs are now building for the Brazilians a huge vessel of 32,000 tons, which will carry an armament of twelve 14-inch guns. Already, there is semi-official talk in this country of building a ship of equal or greater displacement carrying 16-inch guns. One result of the re-introduction of guns of this caliber will be an immense increase in the displacement of future battleships. Due largely to the vigorous policy introduced by Secretary of the Navy Meyer, there has been a marked increase in efficiency in the ships of the U. S. navy that are in commission, and particularly has this been noticeable in the engineering department. Our latest battleships are not only living up, in service, to their contract speeds, but frequently have exceeded them. In 4-hour trials at full power, the "Louisiana" recently made 18.9 knots, and the "Michigan" 19.4 knots, which is about a knot more than the contract speeds. Except in the cruiser-dreadnought class, and in the class of scouts of from 3,000 to 5,000 tons, the cruiser type is no longer being built by any navy. The latest scouts showed 26 knots or more on their trials. As regards torpedo boat destroyers, the tendency is to build larger and more seaworthy vessels of moderate speed, say of 27 to 30 knots. Our own vessels of the "Reid" class have been showing remarkable results under oil fuel, making on trial 32 knots and over. The submarine is forging steadily ahead in reputation, and is to-day readily controlled and, within its limited range, of undoubted efficiency. That it will some day be able to accompany the battleship fleet on the high seas is indicated by a recent voyage of 1,500 miles from Cape Cod to Bermuda and back, accomplished by the United States submarine "Salmon." Toward the close of the year, moreover, a French submersible covered over 3,000 miles during an ocean cruise, in which the little craft was unattended. The work of providing adequate coast fortifications has been carried to a point at which our defenses may be considered to be fairly complete. The full efficiency of these fortifications, however, is not realized, because of the lack of proper mine equipment, and the usual accessories for the mines and guns already in place. To provide for these accessories would involve an expenditure of about fifteen million dollars. The army, in common with the navy, has had some trouble with its heavy artillery, chiefly in the premature ignition of the charge and blowing open of breech blocks, or the bursting of guns. The former is to be remedied by a more perfect system of safeguards, and the latter by extending the hooping of the guns entirely to the muzzle.

The Merchant Marine.

The event of greatest significance to the merchant marine during the year has been the continued increase in the size of ocean steamships. The day has passed when the announcement of the dimensions of these giant passenger ships causes any surprise; and even the expert shipbuilder has ceased to state that the limit of size has been reached. The "Lusitania" and "Mauretania" are huge vessels, with their length over all of 790 feet, and their displacement of over 40,000 tons. During the year, however, there was launched at Belfast the "Olympic," a vessel which is nearly one hundred feet longer than the "Mauretania," or 882½ feet, and whose displacement, largely due to her fuller form, will reach at maximum load draft 60,000 tons. Recently, the Hamburg-American line have definitely stated that their new "Europa" will be 900 feet in length on deck, and that her displacement will be about 65,000 tons. The "Olympic" and her sister ship, the "Teutonic," will have a speed of about 21 knots, the "Europa" of 21½ or 22 knots. The latest announcement by the Cunard Company is that they have decided to build a ship of the same general class, but speedier, whose length will be 855 feet on deck. This vessel will be a compromise between the "Mauretania" with her fine, sharp, under-water body, and the "Olympic" and "Europa" with their generally fuller form. She will be driven by quadruple turbines at a contract speed of 23 knots, and will probably reach 24 knots on trial. Her displacement is given as 50,000 tons. Where these huge ships are to dock at the port of New York is a mystery. A strong effort is being made to induce the War Department to permit the extension of the Manhattan piers farther into the Hudson River. The question of the greater length of merchant steamers is one of channel depth and length of piers. Did no restrictions of this character exist, ships of one thousand feet length would be built; for it is a well understood fact that the larger the ships, the smaller the cost of operation per ton of freight and number of passengers carried. The big ships above referred to will be large cargo carriers, as distinct from such ships as the "Mauretania," "Kaiser Wilhelm" and "Deutschland," which carry only a few hundred tons of high-class freight and express matter. It is not probable that any more ships of the "Mauretania" type will be built, and, unless some radical change in motive power is made, it is likely that she will continue to hold the record of an hourly speed of 26.06 knots per hour across the Atlantic indefinitely.

The most important mechanical development affecting the merchant marine is the attempt to introduce some form of reduction gear between the turbine and the propeller, whereby each may be run at its most economical speed. At present the steam economy of the turbine is largely offset by the inefficiency of the propeller. By the introduction of slowing-down gear, the turbine can be run at the high speed at which its best efficiency is shown and the propeller at its own suitable lower speed. Three notable types of reduction gear have been devised: one by Westinghouse, Melville and MacAlpine; another by Parsons, inventor of the steam turbine, and a third by Dr. Foettinger. The Westinghouse experimental gear has transmitted 6,000 horse-power with an efficiency of about 98 per cent. The gears are helical and the reduction is at the rate of 5 to 1. Parsons has secured the same efficiency in a steamship of 1,000 tons, with ordinary spur gears. Dr. Foettinger uses a hydraulic reduction gear, in which the relative speed of the engine and propeller shafts is regulated by gates interposed between the turbines which compose the gear. Although liquid fuel has continued to make a rapid advance in the navy, its application in the merchant marine has been much slower. In every case, however, where the installation has been well thought out, the results in economy and steaming radius have been encouraging. The internal combustion motor, moreover, is being applied to steamships of ocean-going size, and it is probable that ultimately, though not in the near future, it may become the universal drive for ships, even of the largest size. To the Germans belongs the credit of constructing the first large ocean steamship propelled entirely by internal combustion motors. The new vessel, which will be of 8,000 tons, will be furnished with two Diesel engines, each of 1,500 horse-power. This is a big advance; but the day is yet far distant when the giant liners of which we have spoken above will substitute gas for steam.

Railroads.

There is but little novelty that demands attention in a review of the developments of the year in the broad field of railway transportation. The most notable fact in locomotive practice has been the increasing recognition of the value of superheating, as an adjunct to, if not indeed as a substitute, for compounding. In some tests, carried out in daily operation, simple locomotives using superheated steam have shown results fully equal, if not superior, to those obtained by compounding. There is the added advantage that the superheater may be applied to existing simple locomotives without involving any changes in the valve or cylinder mechanism. Moreover, the locomotive using superheat possesses certain well-known advantages of operation over locomotives of the compound type. Both for freight and passenger service there has been a steady increase in locomotive weight and power. Two remarkable engines are a freight and a passenger locomotive of the Mallet type, built by the Baldwin works for the Atchison and Santa Fe Railroad. The passenger locomotive weighs, with its tender, 305 tons, and has 4,070 feet of heating surface, 1,121 square feet of superheating and reheating surface, and exerts a tractive force of 26½ tons. The forward low pressure cylinders drive four coupled driving wheels, and the after H.P. cylinders are connected to six coupled drivers. The freight locomotive, weighing 350 tons with tender, has 6,621 square feet of heating surface, 1,745 square feet of superheating and reheating surface, and it exerts a tractive force of 54 tons. The boiler, which is built with the excellent Jacobs-Shupert firebox, is equipped with a heating drum forward of the fire tubes, which is divided by a diaphragm into superheating and reheating compartments, the steam being reheated in its passage from the high to the low-pressure cylinders. Beyond this is a second nest of tubes constituting a feed-water heater. Tests in daily service have shown that this boiler saves 25 per cent of the fuel, as compared with simple boilers doing the same class of work. An important development, which has made much progress during the year, is the introduction of steel passenger cars, a work in which the great Pennsylvania system leads the way. During the year the Pennsylvania Railroad terminal station in Manhattan was opened, and put in connection first, through the East River tubes, with the Long Island system, and later, by the Hudson River tubes, with its main line and connections to the west and south. This vast terminal structure, which, with its train yards, covers twenty-eight acres, required as preliminary work the excavation of three million cubic yards of rock, in order to obtain the desired depth below the street surface of 45 feet. To reach the station, 5.3 miles of standard size tunnel have been built below the two rivers and beneath Manhattan Island. The station building, a monumental structure of great dignity and beauty, is constructed of granite, and is generally of the Roman Doric order. That other great terminal structure, the new station of the New York Central Railroad, is progressing slowly, being handicapped by the necessity of continuing in uninterrupted operation the two great railroad systems which center there. It will probably be two years, at the earliest, before the station is opened for traffic. In extent of yard, number of tracks, and general capacity, it will exceed the Pennsylvania terminal. In architectural appearance, however, the Pennsylvania building will remain unchallenged. It is gratifying to note that there is a gradual diminution in the number of railroad accidents, particularly among the leading railroads. Thus, in the year 1908-1909, although the Pennsylvania company carried some 300,000,000 passengers, only one passenger was killed as the result of a train wreck. Other leading roads have shown proportionately smaller death and accident lists. Mention should be made in passing of the increased interest in the so-called gyroscopic railways, due to the exploitation of the Scherl gyroscopic monorail car, which operates on the same principle as the Brennan car that excited so much attention last year. The Scherl car is maintained in equilibrium by two interconnected gyroscopes, whose flywheels weigh only 135 pounds each, and rotate at a speed of 8,000 revolutions per minute. The gyroscopic railway can scarcely hope to compete with the present type employing two tracks, the complication, cost, and delicacy of the mechanism rendering it unfit for the arduous and varied service of practical railroad operation.

The Steam Engine.

The most notable event of the year in steam engine practice has been the increasing appreciation of the value of the turbine as an auxiliary to the reciprocating steam engine; and it is no exaggeration to state that the low pressure turbine has introduced an era of improvement in steam engine practice which is destined to mark an advance in the art, greater than any recorded during the past century in the history of this great prime mover. The reciprocating engine, because of the great dimensions and weights which would be involved in building a low pressure cylinder of sufficient capacity to carry the expansion of the steam down to the theoretical limit, is unable to accommodate economically the expansion beyond a certain point. The steam turbine, on the other hand, is admirably adapted to utilize the steam in the lower ranges of pressure, just as the reciprocating engine is better suited for developing expansion in the higher ranges. A notable demonstration of these facts has been made at the Subway Power Plant in this city. Originally, this plant consisted of nine compound, reciprocating condensing engines of a total overload capacity of 72,000 kilowatts. By the substitution of a low pressure Curtis turbine between the reciprocating engine and its condenser, it has become possible to extract an additional 8,000 kilowatts from the steam when the engine is working at its full overload capacity, thus doubling, at a stroke, the maximum capacity of the whole power plant. Formerly at maximum overload, the water rate was 22 pounds per kilowatt per hour, whereas, under the combined reciprocating and turbine operation, the consumption at maximum overload is only 14.5 pounds per kilowatt per hour. There is thus an increase of 100 per cent in the maximum capacity of the plant, and an increase of 146 per cent in its maximum economic capacity. The operating advantages to be derived from the low pressure turbine in effecting economy in great industrial plants are extraordinary. Steam losses from steam hammers, rolling mill engines, and the other multitudinous high pressure engines which now exhaust directly from the atmosphere, are enormous. We have spoken, under the head of locomotives, of the revival of interest in superheating, the advantages of which for stationary engines have of course long been recognized. In a paper read before the last International Railway Congress Association on the use of superheated steam in locomotives in France, Italy, and other European countries, it was shown that in the case of simple engines, the saving has reached 29.64 per cent of coal and 28.67 per cent of water, this result being obtained on the Belgian State Railway. Other tests between superheated and saturated steam locomotives showed a saving of from 18.20 to 22 per cent. The addition of superheat on the 4-cylinder express compounds of the French Western Railway resulted in an increased economy of 13 to 14 per cent. The year has been notable for a revival of interest in the rotary engine, which at last has begun to show, in one or two types, a steam consumption comparable to that of good reciprocating engines of small power. A 20-horse-power Herrick rotary engine, tested at Stevens Institute, developed 20.40 brake horse-power on a consumption of 44.24 pounds of water per hour, and later in the year, at the same laboratory, a 100-horse-power rotary of the same type, when operating with dry steam at 130 pounds at the throttle, developed a brake horse-power of 128 with a consumption of water per brake horse-power per hour of 32.4. Another rotary engine known as the Harriman type, when tested at the Massachusetts Institute of Technology, developed 25.72 brake horse-power with a consumption of 31.02 pounds of steam per brake horse-power per hour. These results are excellent, and should these engines establish their ability to run in continued service without excessive wear, the rotary engine will at last have come into its own, and will be prepared to take its place as one of the standard prime movers of the day.

Electrical.

The past year, so far as the broad field of electricity is concerned, has not been marked by any startling discovery or epoch-making invention. Rather it has been a period of steady development and improvement. In view of its far-reaching significance and its probable effect upon the future of the electrification of trunk railroads, the recent announcement by the New York, New Haven and Hartford Company regarding the success of the electrical equipment of their lines at New York city must be considered as one of the most important documents of the year. The report was due to the requirement by the Legislature of Massachusetts that the city and suburban railroads in and around Boston be equipped electrically. Both the New Haven and the Boston and Maine railroads protested against the change on the ground of great cost of installation and operation, which they claim will be so large as to necessitate the raising of the passenger rates. The president of the New Haven Railroad, in his report, stated that in spite of the great conveniences of operation resulting from the equipment of the New York to Stamford lines, the financial results have been disappointing. This, he says, is due in part to the mixed character of the traffic, steam and electric operation being carried on over the same division. From this we gather that, were the operation entirely electric, both for passenger and freight service, economic as well as operating advantages would be realized. In this connection, it is significant that the New York Central Company seem to be in no hurry to extend their electrical zone over the whole stretch of line that was contemplated when the change from steam to electricity was undertaken. In spite of the New Haven's report, it is a fact that the company are extending their electric zone from Stamford to New Haven, and are thereby doubling the length of the original electrified line. The competition between the alternating current and the direct current systems continues to be as keen as ever, although the concensus of opinion inclines to the alternating current as the best system for through trunk lines, with a prefer

(Concluded on page 528.)

THE SECRETARY BIRD

BY WALTER L. BEASLEY

A rare and most remarkable bird, practically new to the eyes of the American public, is the Secretary Bird (*Serpentarius serpentarius*, Miller) from South Africa, of which a pair were recently received at the New York Zoological Park. Few visitors, however, who view the stately, long legged creatures stalking about in their outside run or in the inclosure of the ostrich house hardly realize that these queer birds with beautiful plumage and tail feathers two feet long are the famed snake killers. Yet such is the case. As a slayer of serpents the Secretary has gained his greatest reputation.

To the casual observer the bird appears as a long-winged, long-tailed, bluish-gray hawk, mounted upon very long legs. In fact, the bird is considered by ornithologists as a long-legged hawk, highly specialized and adapted for ground hunting. The zoological status of the Secretary Bird has occasioned a good deal of controversy, but most modern authorities admit its affinities with the Accipitrine birds, and place it in a separate sub-order of that group.

The male bird stands four feet high, the greater part of the body being made up of legs and neck. The bird has derived its odd and significant name from the crest of long dark plumes rising from the back of its head; for it looks somewhat like a secretary of comical aspect with quill pen stuck behind his ears. In general color the bird is a bluish-gray, with long unfeathered legs, the wings, thighs, and abdomen black, the breast white. In the male, the naked skin of the face is yellow, with long heavy eye-lashes and large fine gray eyes. The feet are formidable weapons used in attack; the beak, which is short, strong and greatly arched, is never used until after the victim is dead. Each foot is equipped with a sharpened, raised, inner talon, which specialized claw assists in holding the prey during the process of tearing it with the bill. The public, however, is not treated to perhaps the most interesting and exciting performance of the Secretary Bird, namely, that of making a realistic attack upon a snake.

Through the courtesy of Director W. T. Hornaday the writer was given a special opportunity of making some characteristic photographs in the outside run of the ostrich house, showing how this curious and wiry bird attacks and quickly makes away with his victim. All food must be alive. A garter snake was thrown some distance from the male Secretary Bird on the ground. Unlike hawks and vultures, he did not dart upon the prey at once, but cautiously approached the snake with wings partly outspread, so as to be ready to fly out of the way and escape any sudden lunge of the combative serpent. Still watching its movements, the Secretary slowly circled around his antagonist, looking for an opening to strike, but keeping well out of danger. Suddenly, like a flash, the bird raised and shot out one of his powerful feet, armed with huge claws and talons, and struck the snake fairly on the head, stunning it. This was quickly followed by another crushing blow, which proved a death blow. The prey was then quickly swallowed. One of the peculiar battle tactics observed was that the Secretary always aimed its blows at the victim's head. The fighting and killing power of the Secretary is all done by the long, powerful muscular legs. The bird strikes a terrific blow by raising either foot to a position at right angles to the thigh, and bringing it down with great velocity on the head of the victim, which receives not only the force of the blow, but also the effect of the piercing sharp nails of the talons.

He looks like a clerk with quill pens stuck behind his ears and that is why he is called the "secretary" bird.

In South Africa, their favorite haunts, the Secretaries are said to be of great use to the community as destroyers of venomous pests that infest the country, for they quickly wipe out of existence great numbers of cobras, vipers, and other poisonous reptiles that make constant raids upon the farmers' poultry, young pigs, etc. In Cape Colony the birds are protected by sportsmen and hunters on account of the effective warfare which they wage against serpents, and a fine is inflicted for shooting them. Its extreme agility enables the bird in a short time to baffle and overcome a snake four or five feet long. It is said that one of the adroit fighting methods employed by the wiry male bird in a combat with a big five or six-foot reptile, which has given him a game fight on the ground and has proved a stubborn antagonist to subdue, is to watch the opportunity, when he springs and seizes his adversary close to the head, and flying several hundred feet up in the air, letting the snake drop to the hard ground below. The blow is usually fatal and sufficient to prepare the prey for the final ceremony of swallowing.

The secretaries travel in pairs, male and female. If disturbed or pursued their pace is about as fast as that of a running horse.

They seldom use their wings, and if compelled to do so, can soar to a considerable height. They build bulky nests, and where trees are to be had, they select one fifty to one hundred feet above the ground. Their nests are built of sticks, sods, lined with grass, and measure as much as five feet in diameter and three feet in thickness. As a rule only two eggs are laid. Incubation takes six weeks, which is done by the female. The young have to remain in their nests several months before they can stand on their long, slender legs, which are very weak and brittle. The young easily break their legs if disturbed.

Good specimens of secretaries are difficult to secure and are worth about one hundred dollars each.

According to the American Machinist, G. Coles has determined that the proper temperatures for the quenching of steel drills and similar tools is the temperature at which steel loses its magnetic properties. Upon this discovery Coles has based a very simple method of testing the temperature of the tools by removing them from the furnace and placing them at a previously determined short distance from a small netic compass. If the needle is deflected, the tool is returned to the furnace and heated until it fails to affect the needle. It is then quenched.

Garter snakes are delicacies to the "secretary." Here the bird is shown with one foot raised preparing to strike a blow that will kill the serpent.

The secretary kills his prey before he eats him, and he kills, not with his beak, but with his wonderful talons.

He is really a long-legged hawk—is the secretary bird; a long-winged, long-tailed, bluish-gray hawk.

THE SECRETARY BIRD.

THE DISASTROUS EXPLOSION AT THE GRAND CENTRAL TERMINAL.

Of all the accidents that have occurred at railway terminals throughout the world at one time or another, the disastrous explosion which took place at the Grand Central Terminal on December 20th is undoubtedly the worst. Ten killed and about two hundred injured is the list of unfortunates as the result of this explosion.

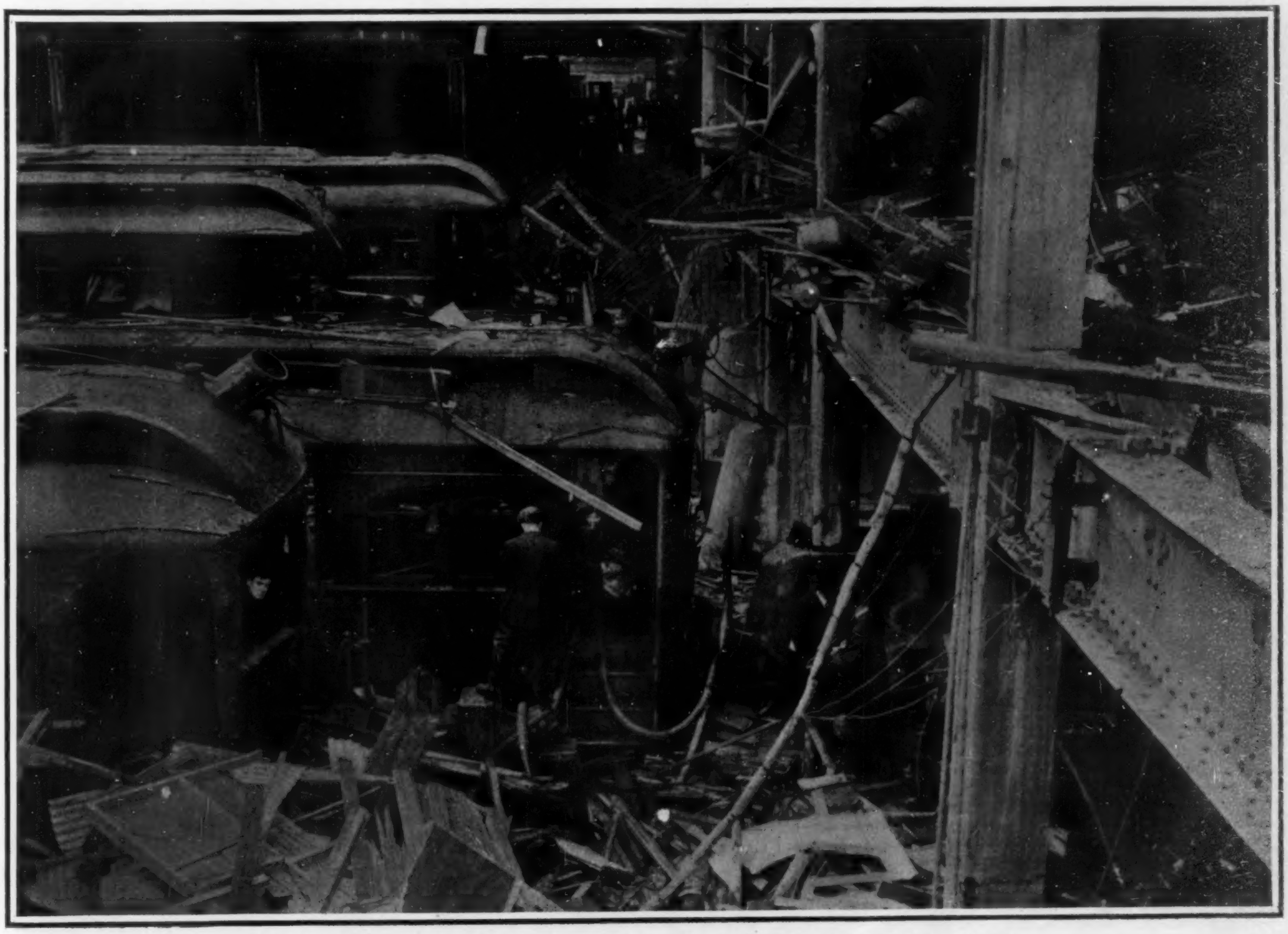
The explosion occurred beneath the new power house on Fiftieth Street and in the submerged yards extending from Lexington Avenue and Fiftieth Street a couple of blocks southward. At the present writing the exact cause of the explosion has not been definitely determined, but it seems to have been due to the explosion of Pintsch illuminating gas diluted with air and ignited by an electric spark. The explosion occurred at 8:22 A. M., twenty-nine minutes after the collision of a runaway train with a bumping post at the northerly end of one of the yard tracks, which terminated at the entrance to the power house. The train in question was being run through the yard at rather high speed, and, when the motorman applied the brakes, he was unable to stop the train owing, he claimed, to a lack of sand in the sand-box. The empty cars struck the bumper at the end of the track and knocked it down. The first car, as it passed off the rails, broke a two-inch gas

(Continued on page 528.)

Street car overturned by the explosion, showing how badly the side was crushed in by the force of the blast.

End view of power house, showing roof fallen to the street.

Power house facing on Fiftieth Street, showing the demolished roof and front.



View of the rear of the power house, showing the submerged yard beneath and the wreckage.

THE DISASTROUS EXPLOSION AT THE GRAND CENTRAL TERMINAL

A PORTABLE COLLAPSIBLE MAST

AN INGENIOUS DEVICE FOR MANY USES

A German inventor has devised a very ingenious construction of masts made of steel bands running lengthwise of the mast and transverse connecting members for holding the steel bands together to form a tubular structure of square or polygonal cross section. Our illustrations show several forms of this new mast, together with the very original mechanism employed for erecting the mast and for taking it down.

While the general principle is the same for all sizes and types of masts, there are certain differences in the construction, according as the masts are to be portable or stationary. The small cut at the left shows a portable mast, before erection, and on our front page other cuts show stationary masts, two of them in course of construction, and the third finished.

Portable masts are made in heights varying from 6 to 130 feet, with either four or six steel bands of best quality, their width being either 1¼, or 2⅓, or 4 inches. The bands are wound on four or six drums, as the case may be. For very small sizes (up to 17 feet) spring drums are used, and the mast is pushed up or drawn down by means of two wheels the teeth of which fit into corresponding holes in two opposite bands. For the larger sizes, the drums are rotated by means of cranks, and the raising of the mast is effected by means of a hoisting device of various forms. In most cases, the hoisting device is operated by one or more cranks, which control either friction wheels engaging opposite bands, or toothed hoisting wheels which fit into holes of some of the bands. With a mast comprising four bands, two are operated in this manner, while a six-band mast has three of its bands engaged by toothed hoisting wheels.

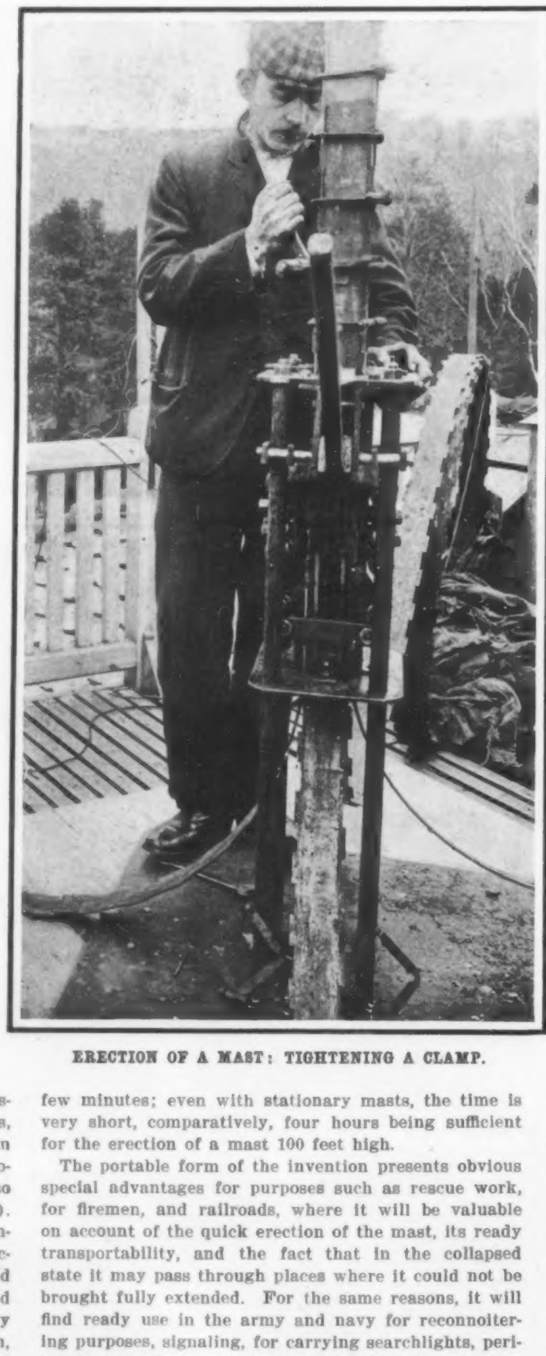
In the case of portable masts, the transverse connecting members consist of plates or frames arranged to surround and brace the tube formed by the longitudinal steel bands. When the mast is completely collapsed these numerous plates are stacked one upon the other and thus occupy very little space. The uppermost plate is secured to the top of the mast, and the other plates are held together loosely by ropes or other flexible connections, so that the plates will be raised successively and automatically as the mast is extended upward by turning the cranks. A small ladder may be attached permanently to the plates to enable a person to climb up or down readily. In the illustration a seat for the person is carried by the upper end of the mast; instead of this, there is provided sometimes a rotary table with a chair and a stand for holding a telescope.

Stationary masts on this principle are made in heights from 50 to 250 feet, and over, with four or six steel bands up to 14 inches wide and up to 1/5 of an inch thick. The masts are raised by means of simple hoisting devices, which for the smaller sizes are operated by levers rocked up and down as shown on this page; for larger sizes the hoisting device is operated by cranks, as shown on the front page. Instead of being permanently connected with the steel bands, as in the portable masts, the hoisting device is detachable, so that the same hoisting device may be used to erect different masts successively. In fact, the manufacturers will rent the hoisting device to their customers. The steel bands are not wound upon drums, but simply coiled upon themselves for convenience in storing and shipping. Their edges have teeth or projections which interlock, and in some cases they also have perforations in the center (see the front page). Instead of connecting plates, two-part clamps are employed, these being applied individually as the structure rises, and drawn tight by means of screws to hold the steel bands together. The clamps may be formed with steps to facilitate climbing the mast. Stationary masts are set upon a suitably prepared foundation, and are generally braced by guy wires, as indicated in the cut in the upper right-hand corner. The top of the mast may carry an extension made of steel tubing, as shown in the same cut.

These masts are used for a great variety of purposes, as supports or carriers for electric lamps or searchlights, for wires or cables, as antennæ for wireless telegraphy, as extensible ladders, as flagpoles, observation masts for military or naval purposes, signal masts or semaphores, for cranes and derricks, posts for scaffolds or buildings, etc.

Among the advantages of the new masts the manufacturers mention in the first place the great strength of the structure, combined with light weight. The safety of the masts is very great, since all joints are longitudinal, and transverse joints are avoided; even in the case of overloading the mast will not break, but simply bend, and the construction is therefore exceedingly durable. The parts required for erecting the masts are shipped readily, as they can be divided into a number of parcels, none of which will be very bulky. Even the coiled steel bands for the stationary masts need not exceed 5 feet in diameter. The parts are not heavy, so that they may be readily handled and transported.

All parts of the finished mast are easily accessible, thus facilitating inspection and repairs. The masts may be put up and taken down readily and in a very short time in any kind of weather (wind, ice, etc., will not interfere) by a small working force, from one to three men being sufficient, and these need not be skilled workers. In the case of portable masts, the time required for erection or taking down is only a few minutes; even with stationary masts, the time is very short, comparatively, four hours being sufficient for the erection of a mast 100 feet high.



ERECTION OF A MAST: TIGHTENING A CLAMP.

The portable form of the invention presents obvious special advantages for purposes such as rescue work, for firemen, and railroads, where it will be valuable on account of the quick erection of the mast, its ready transportability, and the fact that in the collapsed state it may pass through places where it could not be brought fully extended. For the same reasons, it will find ready use in the army and navy for reconnoitering purposes, signaling, for carrying searchlights, periscopes, torpedo nets, tents, sheds for dirigible balloons and for aeroplanes, etc. The portable mast may be mounted on a two-wheeled or four-wheeled truck, and in this form will form a very convenient addition to the equipment of the fire department or of the army. The hoisting device may be operated by a motor instead of manually, thus saving time and labor in extending and collapsing the mast.

In the preparation of iron ore for the blast furnace, relatively little has been done thus far in Germany. Attention has been directed more particularly to briquetting flue dust. Prof. G. Franke, of Berlin, in a paper on the subject, estimates that ten plants with a capacity of 700,000 tons per year handle over 500,000 tons of flue dust, leaving only a relatively small balance for ores. There are in operation the Schumacher chloride of magnesium process, the Tigler lime, the Trainer cell pitch methods, the Ronay high-pressure process, and the Scoria process. Nodulizing has not attracted much attention.

Hydrocarbon Gas by Vacuum Process.

The production of hydrocarbon gas from the volatile products of petroleum, a problem which has baffled engineers for more than thirty years, has now been attacked on a new vacuum principle.

In machines of this type heretofore employed, a difficult problem has confronted the manufacturers, owing to the fact that the hydrocarbon employed (generally gasoline, sometimes known as "petrol" or "motor spirits") is so very non-homogeneous in its nature. Hydrocarbon gas in itself is nothing new, and its manufacture, in spite of this defect, has been considerable, by means of a carbureter, varying in size with the quantity of gas desired, sometimes buried underground, sometimes not, according to the whim of the manufacturer. The carbureter is constituted generally of sheet metal, divided into a series of cells or coils, so arranged as to provide a tortuous passage for the air, frequently filled with cotton wicking, excelsior, and the like. Theoretically, the air by passing through this carbureter would become impregnated or saturated with as much gasoline vapor as the quantity and quality of the gasoline and the condition of the atmospheric air would allow; but gasoline, not being homogeneous or uniform, its lighter and more volatile parts are first taken up by the air, making too rich a gas, until the more volatile parts of the gasoline are used, then becoming thinner and thinner as the gasoline becomes impoverished, and ultimately causing residue and waste. This deterioration of the gasoline was strongly accented and helped along by the principles of refrigerating which set in, and the conversion of a liquid into gas.

As a remedy for this defect, various styles of mixers were adopted, some built on beautiful mechanical theories, but in practice totally unreliable, because of the extreme accuracy with which they were called upon to work, or because they were based on the fallacy that gasoline gas once made can be satisfactorily further mixed with atmospheric air.

Gasoline consists approximately of 17 per cent hydrogen and 83 per cent carbon, and its hydrometric gravity ranges from 60 deg. to 90 deg. Baumé. The 90 deg. is highly volatile, the 60 deg. much less so, showing how non-homogeneous it is, and how necessary it is to control its use uniformly. As the regulation of the speed of flow of the atmospheric air and gasoline is so all-important, it will be readily seen that a machine in which that is accomplished must become highly valuable to the commercial world. While the vacuum principle has long been used in other very popular lines, for industrial purposes, with great success, it is only recently that a gas machine has been designed that employs this principle for the production of gas. In the short time that it has been used it has proved its success.

By this system the air is automatically and uniformly carbureted into a non-condensing proportion of hydrocarbon vapor, under varying demands, fluctuations of temperature, and during indefinite periods of time. The gas produced is non-explosive, non-poisonous, non-corrosive, non-asphyxiating, and its products of combustion are inodorous. When used with an incandescent mantle, the effect is most brilliant.

The gas-making process consists in supplying a very small and graduated quantity of gasoline from the general supply, elevating it by means of miniature buckets, each of a capacity of a few grains, and feeding it by gravity through a small tube into a special chamber formed in one end of the inside drum. For convenience, this chamber may be called the carbureter, and is connected, through a suitably sized pipe or air intake, with the atmosphere without. This carbureter forms one end of the ingeniously constructed drum.

In operation, a partial revolution of this drum draws in the vapor from the carbureter, carries it down under the water, compresses it, and delivers it at the other end of the drum as finished gas. However, the indrawing of this vapor from the carbureter tempo-

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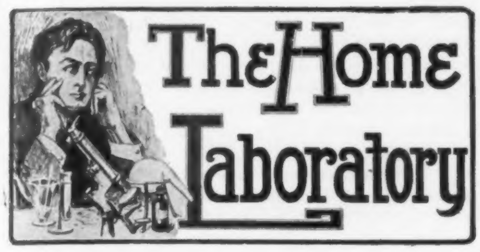


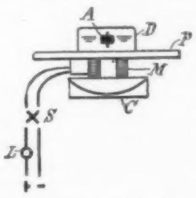
[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

ELECTRICAL PROJECTION EXPERIMENTS.—III.

BY SYDNEY WHETMORE ASHE.

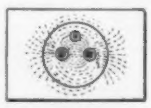
(Concluded from the issue of December 3rd, 1910.)

Camphor on Water.—It is difficult to conceive of many phenomena which occur in nature, whose transformations are not visible to the eye. An instance of this is in the manner in which a magnet may impart its properties to a piece of steel that has been rubbed by it. An interesting case of what one might imagine to be perpetual motion occurs when small particles of gum camphor are sprinkled upon the surface of pure water. If only a few particles less than a pinhead in size are dropped upon the surface, they will float, and will begin to rotate at a rapid speed. Some will rotate in fairly constant location, while others will travel in a circular path around the dish. The smaller particles will be attracted to some of the larger particles. They will travel about like the tail to a kite, and will then be released, due to centrifugal force, and fly apart. Any simple disk and a few grains of solid camphor are all that is necessary to perform this interesting experiment. Where the experiment is performed on a screen with a vertical lantern, the size of the particles is magnified many times, making one of the prettiest and most interesting experiments which may be performed. It is said that the motion which causes this rotation is due to the unequal solubility of the camphor in the water.



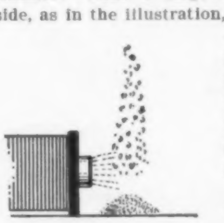
Apparatus for illustrating magnetic lines of force.

Experiment.—Connect a small electro-magnet through a reversing switch and a 16-candle-power lamp in series with a 116-volt direct current circuit. Over the magnet place a glass plate supporting a shallow dish containing water to a depth of ¼ of an inch. The glass dish should be as close to the magnet as possible. Through a small piece of cork about ⅛ of an inch square pass a small piece of needle which has been magnetized. Float the small magnet upon the water so that it will be in an upright position with the north pole submerged in the water. The lower pole will be attracted or repelled by whatever pole of the electromagnet it happens to be near. It is well, before placing the dish in position over the magnet, to cover the electro-magnet with a piece of glass and obtain a magnetic spectrum. By suitably manipulating the reversing switch the unit pole will follow the path of the magnetic field.



Magnet moving along lines of force.

Edison's Ore Separator.—The principle of Edison's ore separator may be readily shown in the following manner: Take a large electro-magnet, lying on its side, as in the illustration, and pass before it a stream of filings and sand which have been mixed. The filings will be attracted to the magnet, and the sand will continue in its path past the magnet, forming a pile.



Principle of the magnetic ore separator.

Many other interesting experiments may be performed with a large electro-magnet. The field may be traced with a nail suspended on a string; a small piece of diaphragm may be laid flat upon the pole of the magnet, when it will stand upright when released, due to its tendency to assist the magnetic field; and filings may be used to show the direction and intensity of the field.

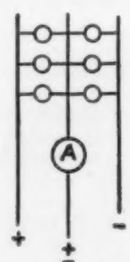
The Pail Forge.—The concentration of energy which occurs in an electrolytic reaction may become very great if the reaction be localized. To show this, take a glass dish of about a gallon capacity—an old battery jar—and fill the bottom of it with a layer of sand in which is imbedded a lead electrode connected to the negative source of a 240-volt direct-current source of supply. The positive terminal should be connected to an iron rod about ½ inch in diameter, the end of which where grasped by the hand is cored with a non-conductor of heat. The dish should be filled with water, and some salt stirred into it. With the current on, place the tip of the rod into the water, which will begin to sputter. When the water has reached almost boiling point, small particles of iron in the form of a shower will be thrown out from the contact point. The point of the iron rod will become white hot, small particles of molten iron falling to the bottom of the glass vessel. When this state is reached, remove the iron rod from the vessel, shake it, and a shower of iron sparks will fall on the floor. Care should be taken in doing this to see that the molten particles do not set fire to anything. The experiment is most effective in a darkened room.

Action of Motor Counter E.M.F.—The current which passes through the armature of a motor is numerically equal to the difference between the line E.M.F. and the counter E.M.F. divided by the resistance of the armature:

$$I=\frac{E-E}{r}$$

As the speed of the motor increases, the counter E.M.F. increases and the current input decreases. This may be readily shown on the screen by means of a projecting ammeter connected in the line circuit of a ½ horse-power motor. At starting the various jumps of the line current are seen on the screen. When the motor is operating at normal speed, place the hand upon the motor pulley, and slow it up. The current input will keep increasing as the speed of the motor decreases. When the pulley pressure is released, the armature will speed up and the current input will decrease, the variations of the current being followed by the projected ammeter reading on the screen. By turning the starting box handle on at various rates, the disadvantages of starting a motor too rapidly may be readily shown.

Current in the Neutral Feeder of a Three-Wire System.—The action of the current in the neutral feeder of a three-wire system may be shown with a projecting ammeter having a central zero, bringing out the fact that when the load on the three-wire system is balanced, no current will flow in the neutral feeder. Use a lamp board containing six 16-candle-power lamps, three on each side of the 120 to 240-volt three-wire system, an ammeter being placed in the neutral feeder. With all of the lamps on one side turned off, start slowly, turning on one lamp at a time on one side of the system until three are turned on. The curret input will keep increasing, reaching a maximum with the third lamp. When this point has been reached, start turning on the lamps on the other side of the system. The current passing through the neutral feeder will begin to fall, reaching zero when all of the lamps have been turned on. Turning off the lamps on that side of the system where the operation was begun, the deflection of the ammeter will reach a maximum in the opposite direction. In practical installations for underground distribution, it is customary to run one neutral feeder for several pairs of outside feeders. It is possible, when the load on a three-wire system is balanced, to have unbalanced potential on the mains, due to trolley current flowing through the neutral feeder.

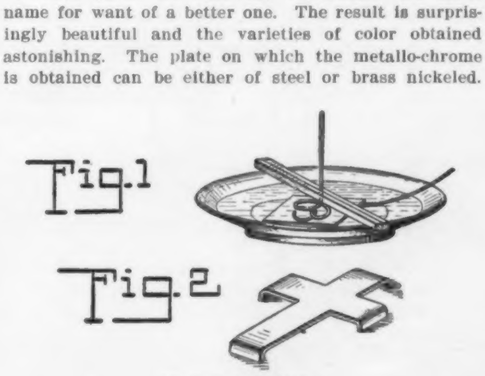


Neutral feeder in three-wire system.

METALLO-CHROMES.

BY W. J. C.

I have given the following experiment the above name for want of a better one. The result is surprisingly beautiful and the varieties of color obtained astonishing. The plate on which the metallo-chrome is obtained can be either of steel or brass nickeled.



METALLO-CHROMES.

The latter is of course the more attractive in its results but costs considerably more. Whichever is selected must be polished highly and free from all grease. Using great care that the fingers do not touch the surface, place the plate, polished side up, in a shallow plate such as a soup plate. The anode cut to the design to be transferred to the plate is made of brass plate or wire and held over the plate as shown; the anode is then connected to the carbon end of a two-cell battery, the plate being previously attached to the zinc. The solution is then poured slowly, so as to cover both plate and anode completely.

The design of the anode will be transferred to the surface of the plate, the sharpness of the image depending on the distance between both. When the anode is some distance away, say, ¼ inch, the edge is vignetted or shaded off.

I give two solutions; others will suggest themselves to the reader:

1. A strong solution of acetate of lead.
2. 200 grammes of caustic potash, 2 quarts of distilled water; add 150 grammes of litharge. Boil one-half hour. Let it settle and decant. Dilute with equal parts of water.

One use to which this experiment can be put is the making of door plates.

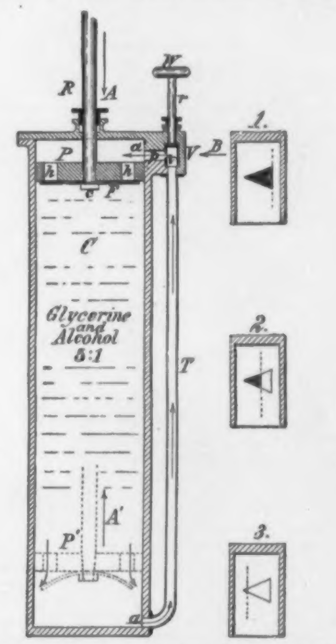
Fig. 1 shows the arrangement in the plate with the anode supported by two pieces of wood.

Fig. 2 shows an anode in the shape of a cross. This, made of brass, with the ends turned down as shown will give a sharp image at each end and a vignetted effect around the body. The same one reversed would give a sharp body with the ends vignetted. It will easily be seen that in order to obtain an even deposit or image the anodes must be perfectly flat and be suspended parallel to the plate.

A SUBSTITUTE FOR A TELESCOPE DRIVING CLOCK.

BY PROF. FREDERIC R. HONEY, TRINITY COLLEGE.

An excellent substitute for a driving clock has recently been designed for the purpose of keeping a star in the field of vision; i. e., to give a very slow, uniform motion to a telescope around the polar axis in a direction contrary to that of the earth on its axis.



SUBSTITUTE FOR A TELESCOPE DRIVING CLOCK.

A cylinder C is filled with a mixture of glycerin and alcohol in the proportion of 5:1. A flexible valve F is fastened at its center c to the under surface of a piston P, which rests upon the glycerin. When the piston moves in the direction of the arrow A, the piston rod R imparts motion to the gear for reducing the motion at the polar axis. As long as there is no outlet for the glycerin, the piston rests upon it, and no motion is communicated to the telescope. When the latter has been adjusted for right ascension and declination, and a star has been brought to the center of the field of vision, its position may be maintained by allowing the glycerin to escape from the lower end a to the upper end of the cylinder through the tube T; and the piston descends by its own weight, giving motion to the telescope. This may be regulated to any speed by enlarging or diminishing the area of the orifice at the upper end of the cylinder a, and is accomplished by means of a hollow cylindrical valve v, whose lower end is open to, and forms a continuation of, the tube T. This valve is operated by the hand wheel W, by which it may be rotated within the valve chest V. Fig. 1 is an enlarged view of a section of the valve taken through its axis, and shows the triangular form of the orifice through which the glycerin passes as seen in the direction of the arrow B. In Fig. 1 the valve is wide open to the passage p; and this area is designed to be a great deal larger than that which is needed for the purpose. Figs. 2 and 3 show the valve after it has been rotated, and the area of the orifice diminished, which may be reduced to the size of a pinhole. The correct position, which can be determined experimentally, is somewhere between the extreme positions, shown at Fig. 2.

When the piston has reached the lower end of the

cylinder (shown at F^{x}) it is restored to its original position by moving it in the direction of the arrow A^1. The valve F opens, and the glycerin passes through the holes h, h. The packing glands prevent any escape of the glycerin around the piston rod R and valve spindle r.

A PHOTOGRAPHIC TELESCOPE.

BY NORMAN BARDEN.

It is possible to do good work in celestial photography with simple home-constructed appliances. The constructing, however, of an instrument together with its mounting, suitable for the purpose of celestial photography, requires good workmanship. The guiding of a photographic telescope requires good eyesight, steady nerves, and most of all, patience. The accompanying figures are taken from a photographic telescope which is now in use by the writer, and has been found to be satisfactory for photographing stars, comets, nebulæ, and the sun and moon.

Fig. 1 is a side view of the mounting, showing nearly all the principal parts, and gives a general idea of the appearance of an equatorial mounting. The standard is made from a well-seasoned 2x4 foot plank of suitable length. The surfaces are all well dressed, but surfaces 1 and 2 are made perfectly flat and at right angles to each other. The line *BB* is drawn perpendicular to the side 1. Then the line *AA* is drawn to make an angle with *BB*, that is equal to the latitude of the observer's station. The plank is now cut off along *AA*, care being taken to have the new surface perpendicular to the side 2. It will now be seen that when the sides 1 and 2 have been put in a vertical position, the line *BB* becomes level, and the

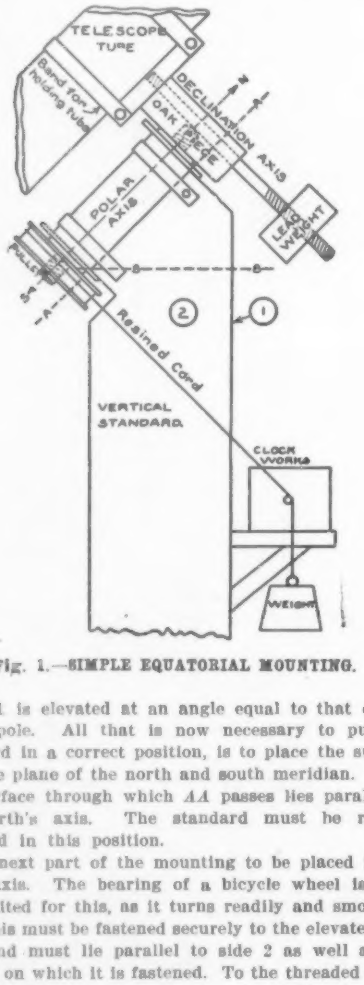


Fig. 1.—SIMPLE EQUATORIAL MOUNTING.

line *AA* is elevated at an angle equal to that of the north pole. All that is now necessary to put the standard in a correct position, is to place the surface 2 in the plane of the north and south meridian. Then the surface through which *AA* passes lies parallel to the earth's axis. The standard must be rigidly fastened in this position.

The next part of the mounting to be placed is the polar axis. The bearing of a bicycle wheel is very well suited for this, as it turns readily and smoothly. This axis must be fastened securely to the elevated surface, and must lie parallel to side 2 as well as the surface on which it is fastened. To the threaded north end of the axle, a bearing for the declination axis must be affixed. This can be made from a piece of stout oak of about 1x2x3 inches. For tapping the oak to fit the threads of the axle, drill a hole in the oak the size of the root of the threaded part of the axle. The oak piece may then be screwed on the axle, and a tight fit obtained. Through this oak piece drill a hole the size of the rod to be used as the declination axis, as shown in Fig. 1. Quarter-inch gas pipe is suitable for this axis, as it is strong and light, and can be easily threaded with standard dies. Each end of the pipe must be threaded, one end being threaded for about four inches. The length of this pipe depends upon the weight of the telescope, as this pipe will hold the weights for balancing the telescope. A 14-inch piece of pipe is usually long enough. This axis may be fastened to the telescope in the same manner as the polar axis was fastened to the declination axis bearing. However, the declination axis must be perpendicular to the polar axis, and the telescope perpendicular to the declination axis.

In order to give long exposures upon stars, comets, and nebulæ, the telescope must be made to follow the heavens in its diurnal motion. This is done by using a clockwork to drive the polar axis from east to west. The telescope can be made to follow the stars very well in the following manner: Procure the bare works of an alarm clock. Find the circumference of the minute-hand shaft. Then make a wooden pulley the circumference of which is twenty-four times that of the minute-hand shaft. Fasten this pulley to the

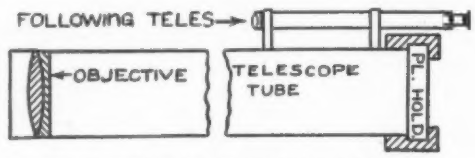


Fig. 2.—DIAGRAM OF TELESCOPIC CAMERA.

lower end of the polar axis. Then fasten the clockwork to the standard, so that the shaft projects out on the west side of the mounting. Fig. 1 gives a clear idea of the arrangement. Now attach a stout, well-resined cord to the pulley, wrap it around from east to west a few times, then stretch it to the shaft on the clock and wind it around about three times, and let it dangle with a weight of about half a pound attached to it. The cord must be wound around the shaft, so that when the shaft turns, the polar axis will turn from east to west. It will now be seen that when the shaft turns twenty-four times, as it would in a day, the polar axis will turn around once, just as the stars seem to make one revolution about the earth in twenty-four hours.

The constructing of the photographic telescope will come next. Fig. 2 shows the general shape and plan of the instrument. The object glass is the first essential to be considered. An achromatic lens, the focal length of which is less than forty inches, will be fit to use, but lenses of greater focal lengths, and not corrected for the actinic rays, are incapable of producing good negatives. The tube of the telescope should next be made. Tin tubing painted black or red on the inside will make a good tube for the telescope. The tube should be large enough to allow the lens to slip into it, and long enough to allow the lens to be slipped in or out, so that a sharp image may be projected upon the plate. As for the plate holders, it is best to buy them ready made. A simple device for holding the plate holder is shown in Fig. 2.

It is absolutely necessary to have a finder and a following telescope on a photographic telescope, where long exposures are to be made. A small telescope, magnifying from ten to twenty diameters, will suffice for both of these requirements. These telescopes can be obtained at a small expense at any optician's. To be able to keep the star in the same position in the finder, two wires crossing each other at right angles are placed in the focus of the eye lens of the eyepiece. The wires must cross at the center of the field of view. (See Fig. 3.) The position in which the star is placed and kept is also shown in the same figure. The following telescope must be firmly attached to the large telescope and parallel to it. If this is done, the object appearing on the cross wires will be projected upon the center of the plate. The whole telescope should now be weighed, and a weight of about one half the telescope's weight constructed. Tap the weight in the center to fit the threads on the declination axis. Now the telescope is made to balance on the declination axis, and is fastened to it as shown in Fig. 1, and the telescope and weights are made to balance on the polar axis. When the photographic telescope is completed, it should meet with the following requirements:

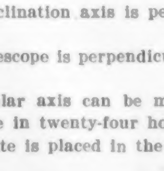


Fig. 3.—CROSS HAIRS IN THE EYEPIECE.

1. That the polar axis is elevated to an angle equal to the latitude of the observer's station.
2. That the polar axis lies in the plane of the meridian.
3. That the declination axis is perpendicular to the polar axis.
4. That the telescope is perpendicular to the declination axis.
5. That the polar axis can be made to turn from east to west once in twenty-four hours.
6. That the plate is placed in the proper focus of the objective.

To try out the instrument, place the plate holder with a plate in place. Get a bright star in the finder; and place it as shown in Fig. 3. Start the clockwork, draw the dark slide of the plate holder, and expose for about ten minutes. With but a trifle variation in the speed of the clock, the star should be made to keep the same position in the finder. Develop the plate, and if the plate has been in the focal plane of the objective, and the telescope has been guided correctly, the star will appear as a sharp, round dot. A few trials of this sort will bring out the defects of the instrument, which must be corrected before good results can be expected.

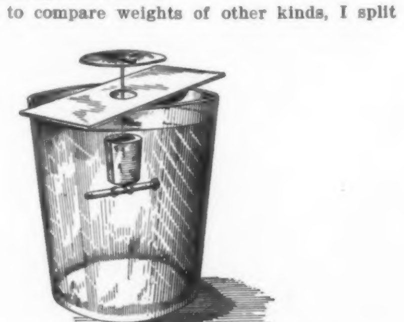
In regard to the length of exposures to be given, only a few suggestions can be given. The moon can be successfully photographed in one or two seconds. The sun requires a shorter exposure of about one-quarter second, with the aperture reduced to about one-half inch. Stars, comets, and nebulæ require long exposures and careful guiding. Exposures of one hour generally give good results. A fast plate is used to advantage in photographing stars, comets, and nebulæ, but for the sun and moon a slow plate is required. Celestial photography will be found to be a pleasure, as well as instructing, by all those who try it. The celestial photographer will never lack for subjects, as there is always some interesting object in the heavens that is willing to impress its image upon the sensitive plate.

A CHEAP HYDRO-COMPARATOR.

BY GEORGE N. WILCOX.

Having a pair of cheap balances, and finding that the weights did not agree, I made a one-grain weight by cutting a piece of No. 23 copper wire (as nearly as possible) 1.113703 inch long. I used a steel scale graduated to hundredths, and a microscope; but if you make it 1⅛ inches by a yardstick, and file off a hundredth as near as you can guess, and trust the diameter of the wire to be accurate (0.022571 inch) you will probably come nearer than some weights you might buy. For other sizes of wire (if you have no table giving length per pound) multiply the length of each smaller size (larger number) by $\sqrt[3]{2} = 1.26$, and for a larger size divide. A No. 24 should be 1.113703 inches by 1.26 inches long, and a No. 26 should be twice as long as a No. 23.

Now, to compare weights of other kinds, I split a



HOME-MADE HYDRO-COMPARATOR.

cork half through, as the boys do for a fishing float (though I used a somewhat smaller one) and put it on a piece of the No. 23 wire, twisting it around a couple of nails below the cork to keep it right side up. About an inch above the cork the wire was coiled and then stitched into a piece of paper the size of a quarter to form a scale pan.

This float may be placed in a glass of alcohol, weighting it down after putting on say the one-grain wire weight, until the cork is completely submerged. After this it will be found that a very small bit of paper will sink it considerably lower, in fact it will probably go down and wet the paper scale pan as mine did many times, unless you put a piece of pasteboard over the glass with a hole in it for the wire, but not large enough to let the pan through.

Now see how far the cork is below the surface, and take off the one-grain weight and put on the weight you wish to compare, and see if the cork is higher or lower. If allowed to stand a few minutes, the position of the cork may change for some reason which I cannot explain; but allowing only time enough to come to rest, and changing your weights several times, you can probably get them nearer alike than by any other method which is as cheap.

Perhaps I should explain that when weight is added, enough extra wire is submerged to displace liquid equal in weight to the weight added, so a larger wire would give less motion, though a smaller one seems to be more affected by uncertain conditions.

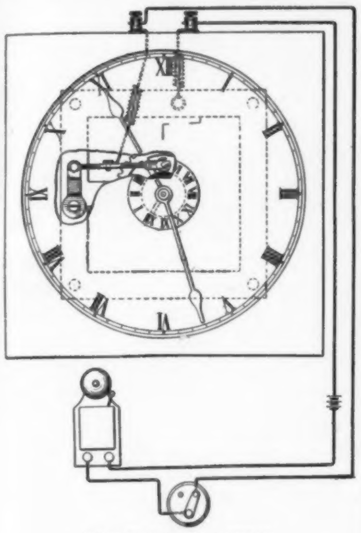
With water instead of alcohol, it acts as if there were more friction, the cork staying in the position placed to a certain extent.

According to George S. Bliss, chief of the United States Weather Bureau of Philadelphia, J. Armstrong Drexel rose to a height of 9,897 feet in his flight to make a new world's altitude record for aeroplanes in Philadelphia on November 23d. Johnstone's record was 9,714 feet. It is not likely that Drexel's record will be accepted, because it has been decided to record only those which exceed previous records by 100 meters.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC TIME SIGNAL.—J. I. JOHNSTON, Graham, Missouri. An alarm signaling device, which may be applied to a clock already in use or be built into a clock as originally constructed, forms the subject matter of a patent recently granted to Mr. Johnston. The signaling apparatus consists of a signal bell and battery circuit, one terminal of which is connected to a brush bearing against a

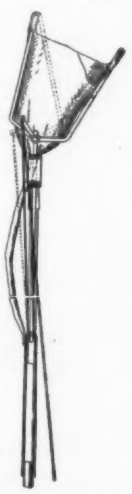


ELECTRIC TIME SIGNAL.

disk of insulated material, while the other is connected to a segment in the aforesaid disk. The disk is mounted on the cannon of the hour hand, and connected therewith is a small dial on the face of the clock. To set the alarm for any desired hour, the dial is turned so that the brush will come in contact with the metal segment when the hour hand of the clock reaches the desired hour.

Of Interest to Farmers.

FRUIT PICKER.—L. THORSTENBERG, Assaria, Kansas. To prevent fruit from being bruised when picked, a fruit picker with flexible holder has been invented, in which provision is made for varying the capacity of the holder to obviate the necessity of dropping the fruit to any distance. As shown in the illustration, the fruit picker comprises a pair

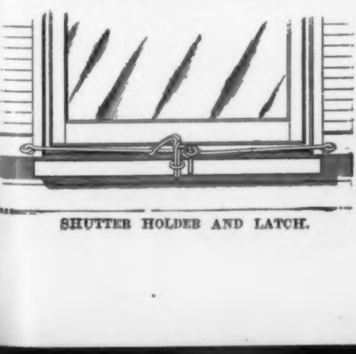


FRUIT PICKER WITH EXPANSIBLE HOLDER.

of jaws, shown open, in full lines, but which may be drawn to a closed position, shown in dotted lines, by operating a lever connected to one of the jaws by means of a wire. A bag mounted on the jaws passes through a slotted yoke, which limits its capacity. By sliding a sleeve upward, the jaws are raised, drawing the bag out of the yoke, and increasing its capacity.

Of General Interest.

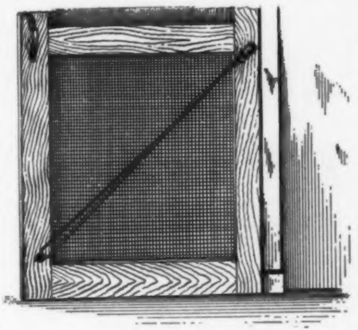
SHUTTER MANIPULATOR AND FASTENER.—R. T. MARSH, 347 Hampton Street, Rock Hill, S. C. As shutters are ordinarily constructed, it is necessary to raise the windows considerably to per-



SHUTTER HOLDER AND LATCH.

mit one to reach out and unlatch the open shutter so that it may be drawn to a closed position. Pictured herewith is a method of fastening the shutters in such a way that they may be operated when the windows are raised only a few inches. Secured to each shutter of the window is a rod terminating in an eye with one rod passed through the eye of the other. Secured to one of the rods is a latch made of twisted heavy wire which is arranged to pass through both eyes of the rods when the shutters are thrown open, and also to engage an eye on the window ledge. Thus the shutters may be locked in open position.

DOOR STAY.—O. EATON, 5 Merrill Street, Portland, Maine. Screen doors are usually of such a light construction that they are apt to sag after a little use. In order to pre-

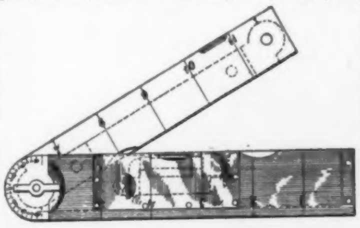


STAY FOR SAGGING DOORS.

vent such sagging, or to correct such a condition in an old door, a simple form of stay has been devised consisting of a hook placed at the lower outer corner of the door, to which a wire is attached extending to a bolt at the opposite corner of the lower panel of the door. The wire is doubled and the bolt is so arranged that it may be turned to twist the wire, thus shortening it and lifting the sagging side to normal position.

Hardware.

RULE.—D. E. WERTS, Olympia, Wash. A combined square, level, and bevel is pictured in the accompanying engraving, in which means are provided for clamping an arm pivoted to the body in any desired angular position relative to the body. At the pivot

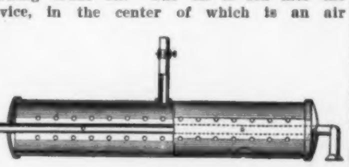


COMBINED SQUARE AND PROTRACTOR.

there is a dial graduated in degrees of arc, whereby the angle at which the arm is set may be determined. The body or stock of the tool is fitted with a glass level tube bent at right angles, so that it may be used for leveling in two directions. An adjusting screw is provided for adjusting the position of the level glass.

Heating and Lighting.

CRUDE OIL BURNER.—E. A. WALES, Waterloo, Iowa. The device illustrated in the accompanying engraving provides means for burning crude oil. The oil is fed into the device, in the center of which is an air



CRUDE OIL BURNER.

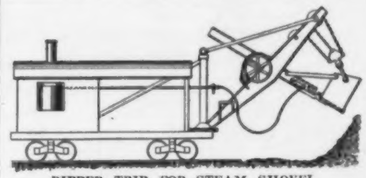
pipe, supplying air for combustion. The air pipe is so disposed that the gas which is produced from heated oil is mixed with it in such manner as to produce intense heat. The device is particularly efficient because the air is delivered within the cylinder to the gas, where it is in the best condition for uniting with the oxygen to form a combustible mixture.

Machines and Mechanical Devices.

ADDING-MACHINE.—W. H. CALLAHAN, Utica, N. Y. In this case the invention refers to improvements in adding machines, and has for its principal object the provision of a mechanism to automatically and accurately form and display results in total form of the addition of various numbers when the same are successively indicated on the machine.

SKEWER-MAKING MACHINE.—R. A. GROVER, Andover, Maine. The invention comprehends, among other things, a grinding wheel for rounding pins, a feed roller for bringing the blanks into contact with the wheel, a friction plate for holding the partly finished blank loosely in contact with the wheel, and cutting devices for shaping the head and point of the blank, thereby completing the skewer.

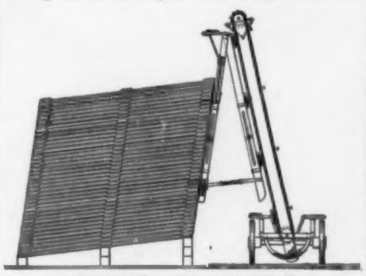
DIPPER TRIP FOR STEAM SHOVELS.—ALBERT H. GEDDES, Empire, Canal Zone, Panama, C. A.



DIPPER TRIP FOR STEAM SHOVEL.

This invention provides an efficient dipper trip for use in connection with steam shovels, dredges, and the like, by which the door of a dipper or bucket may be released mechanically, thereby obviating the necessity of pulling manually upon a rope, or the like, to empty the bucket. The mechanism may be operated by steam or other fluid under pressure, and, after each operation, is returned to the normal position by means of a suitable spring.

LUMBER STACKER.—C. A. DENISON, Gibson, Louisiana. To assist in stacking lumber after it has reached a height of six or seven feet, when it is inconvenient to do the work manually, a machine has been invented consisting of a conveyor belt which lifts the

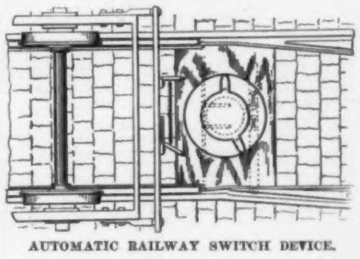


LUMBER-STACKING MACHINE.

planks one by one. The machine comprises a skid formed of a pair of arms, one of which bears against the stack already piled, while the other lies adjacent to the conveyor belt and forms a guide against which the planks are supported while being lifted. The stacker is adjustable to any desired angle.

Railways and Their Accessories.

AUTOMATIC RAILWAY SWITCH DEVICE.—R. I. PARTIDA, Box 93, Torreon, Mexico. The purpose of this invention is to provide an improved automatic method of throwing a railroad switch by means of trip arms engag-



AUTOMATIC RAILWAY SWITCH DEVICE.

ing triggers on a railroad car. The trip arms are normally disposed out of operative position, but are raised to operative position by means actuated by contact with wheels of the car. Means are also provided for protecting the mechanism from damage when any of the movable parts are prevented from operating.

DEVICE FOR DELIVERING MAIL FROM MOVING TRAINS.—E. R. ROBINSON, Gibbstown, N. J. A novel form of mail-delivering apparatus is here illustrated, which consists of a receptacle for mail pouches that may be extended from the side of a moving car to

MAIL-DELIVERING MECHANISM.

support the mail pouches that are to be delivered. In connection with this platform, there is a stationary mechanism at the side of the track, which sweeps the pouches off the receptacle into a receiving cage. The engaging members of the stationary device and the retaining members at each side of the platform are arranged to yield if struck by a non-yielding member.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. **Please state the name of the patentee, title of the invention, and date of this paper.**

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of June 18th, 1910, or will be sent by mail on request.

(12339) **L. J. K. says:** The pumps of a fire boat having a capacity of 13,000 gallons per minute with 150 pounds pressure on the pumps, and 75 pounds pressure on the nozzle; how many 1½-inch nozzles will it supply? A. Practical hydraulic formulæ depend upon empirical constants or coefficients, determined by experiment, which modify the theoretic values deduced by calculation. The quantities and pressures connected with fire nozzles are particularly difficult to connect by theoretic calculation, though Merriman's "Hydraulics," which we catalogue at $5, gives a good discussion of the matter. J. T. Fanning, before the American Water Works Association, in 1892, gave a table of quantities and pressures, from which we note that one 1¼-inch nozzle with 68 pounds pressure throws 388 gallons per minute, while one 1⅜-inch nozzle with 65 pounds pressure throws 468 gallons. Apparently a 1½-inch nozzle would throw about 540 gallons at 65 pounds, and nearly 600 at 75 pounds, so that you could supply say twenty nozzles, provided always that you have hose or pipe area enough to bring the water to the nozzles at 75 pounds pressure. In Fanning's "Water Supply" another set of experiments indicates that these values may be twenty-five per cent too high.

(12340) **O. D. E. says:** Will you please inform me of a metal that is the most resistible to the penetration of magnetism? I want to put a piece of steel and a magnet close together with something thin between them that will prevent their attraction. A. There is no metal which can be used with a magnet to cut off the magnetism from the space around the magnet. Magnetism passes through all metals and other substances with little difficulty, and is not cut off by any. A heavy iron or steel cover over a magnet will inclose its magnetism, by furnishing an easier path for the magnetic lines than the air furnishes, so that the magnetism remains in the iron cover, and does not leave the iron for the air. This is the philosophy for the use of iron cases upon watches which are exposed to magnetism.

(12341) **F. E. says:** 1. Kindly tell us when a gyroscope is spinning at high rate of speed does it lose on its weight? A. The weight of a rotating gyroscope upon the earth is just the same as if it were at rest upon the earth. Gravitation attracts every particle of matter, whether it be at rest or in motion. 2. Is an electromagnet any heavier when charged with electricity? A. The weight of an electromagnet is not affected by sending an electric current through its coil. It weighs the same under all electrical conditions. 3. How many revolutions per minute will be needed to repel a bolt which weighs say 10 tons from the earth by centrifugal force? A. If the earth rotated seventeen times as fast as it does, all things on the equator would lose all their weight; and if it went any faster than that, a ball of ten tons or any other weight would leave the earth and fly off into space. The weight of the ball is not involved in the question. Only the velocity of the earth is involved. If the earth went at that speed, a day would be only one-seventeenth as long as at present, or 1 hour, 24 minutes, 42 6/17 seconds long. In other latitudes the speed would require to be much greater to produce such a result.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending December 20, 1910,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Legal Notices

Antiskid device or chain, R. N. Evans	979,139
Anvil with vise attachment, J. McKenney	979,079
Aqueous solutions, continuous electrolysis of, Pietzsch & Steinbuch	978,934
Armature windings, forming coils for, J. Burke	979,375
Asphalt paving plant, C. I. Williams	978,973
Automobile engine starting device, Russell & Lavoie	978,939
Automobile radiator, G. Enrico	979,137
Axle skein, A. H. & C. W. Bevil	979,368
Bag feeding mechanism, G. L. Hoyt	978,887
Baling press, R. Y. Mitchell	979,022
Baling press, J. Barens	979,055
Bat, base ball, J. R. Dean	979,266
Batteries, etc., connection for storage, L. H. Worne	978,978
Battery cell, electric, J. H. Gugler	979,153
Battery system, combined primary and secondary, J. H. Gugler 979,154,	979,155
Bearing, antifriction, E. S. Woods	979,120
Bearing for railway cars, antifriction, E. S. Woods	979,119
Bearings, sleeve to guide the cages in roller, C. S. Lockwood	979,317
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Threads, etc., manufacturing masses for making artificial, R. Linkmeyer	979,013
Tile, J. Freund	979,280
Time recorder, workman's, Tran & Cais	979,108
Tire, H. E. Moebus	979,325
Tire antiskid device, Evans & Hamm	979,140
Tire antiskid device, P. T. Hamm. 979,159,	979,160
Tire holder and trunk support, spare, L. P. McKinney	979,188
Tire tool, vehicle, C. H. Frazier	979,279
Tire tread, motor vehicle, M. A. Kennedy	979,008
Tobacco leaf stringing machine, O. & A. Graf	979,287
Tobacco pipe, P. P. Sullivan	979,352
Tool driver, spiral, F. E. Davis	979,132
Tool, electropneumatic, J. T. Hillhouse	979,164
Torpedo, automobile, W. M. Douglas	978,862
Towel supply device, I. L. Park	979,029
Trace fastener, C. F. Bloom	979,369
Track, sectional, G. A. Olson	979,028
Track shifting machine, H. T. Devitt	978,858
Transom support and fastener, C. J. Ericson	979,138
Trench filling apparatus, W. G. Howes	978,886
Trolley circuit connection, C. W. Whaley	979,116
Trolley retractor, L. B. Stanley	978,953
Trolley wheel guard, E. E. Kelley	979,311
Trough. See Feed trough.	
Truck, adjustable, J. Porteous	979,093
Truck equalizer, six wheel, E. Posson	979,033
Truck, handle, W. H. Archibald	979,053
Truck, piano, G. A. Perry	979,089
Truck side frames, adjustable column guide for, C. S. Shallenberger	978,946
Tube cleaning apparatus, E. E. Hauer	979,295
Tunnel form, C. D. McArthur	979,185
Turbine, steam, H. B. Lee	979,077
Twyer stock, A. G. McKee	979,187
Type mold, adjustable band, A. S. Taylor	979,222
Typewriter escapement mechanism, W. R. Fox	978,871
Typewriting machine, A. G. F. Kurowski	978,902
Typewriting machine, L. Ney	978,926
Typewriting machine, Seib & Koerner	978,944
Typewriting machine, Gibbs & Sokolov	979,000
Typewriting machine, C. E. Smith.979,215,	979,216
Typewriting machine, F. J. Tanner	979,355
Umbrella, convertible cane, M. Bearman	979,122
Underreamer, J. C. Swan	979,106
Vacuum cleaning apparatus, L. W. Serrell	979,210
Vacuum cleaning tool, H. A. Fergusson	978,869
Valve, E. O'Malley ....978,927 to	978,930
Valve, combination, W. B. Davis	979,384
Valve, engine, J. Rothchild	979,097
Valve gear, T. Hall	979,002
Valve gear, H. F. Shaw	979,212
Valve gear, steam engine, J. P. Phillips	979,031
Valve mechanism, explosive engine, T. L. Moore	979,024
Valve seating attachment, J. M. Gibbs	979,068
Vault mold, grave, W. Dennis	979,062
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Vehicle frame, W. S. Harley	978,881
Vehicle frame suspension, G. Fornaca	979,278
Vehicle shock absorber, W. J. Pierce	979,032
Vehicle spring, shock absorbing, N. Luxembourger	979,016
Vehicle wheel, W. H. Fahrney	979,269
Veneer box for berries, etc., collapsible, O. C. Fenlason	978,868
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Washer. See Bottle washer.	
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Wrench, H. D. Smith	979,348

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since October 4th, 1859, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., Inc., 361 Broadway, New York.

OUR NINE BILLION DOLLAR CROP

THE Report of the Secretary of Agriculture, recently issued, states that the farm products of this country for 1910 are valued at the stupendous figure of nearly $9,000,000,000.

"Nothing," says the Secretary of Agriculture, "nothing short of omniscience can grasp the value of the farm products of this year." At no time in the history of the world has any country equalled this record. Do you know why it is that we reap a golden harvest of $9,000,000,000 in our fields? Do you realize that all this is the work of the microscopist, of the man who has painstakingly discovered in the laboratory some means of curing the diseases of soil and plant; of the scientific manager who has placed the farm upon a business basis and supplanted the old haphazard methods by the system which we now find in every well-regulated shop and mill? Do you realize that "horny-handed son of the soil" is an obsolete designation of the modern American farmer? That he is no more horny-handed than you? That he works with brains, with chemicals, with bacteria and with machines. That he drives an automobile now instead of a rickety wagon drawn by a weary nag? In the mid-month February number of the "Scientific American" we intend to picture this wonderful scientific rise of American agriculture. We are going to tell how much more intelligence has accomplished on the farm than mere muscle; how plants, such as the cactus, which we once regarded as noxious, have been converted into delicious fruit by scientific means; how fruits have been created for which a name had to be invented; how the colors of nature have been changed at will and the flowers painted, as it were, by the hand of the scientist; how the soil is vaccinated with bacteria at four cents an acre in order to enrich it with nitrogen. It is a wonderful scientific work that the modern farmer is doing, just as wonderful as that done by the astronomer in his dome or the electrician in his laboratory. The story of this wonderful work is to be told by men who have helped to make agriculture a scientific pursuit; in other words, by the men to whom this country owes a large part of its $9,000,000,000, reaped by the farmer this year together with his wheat and corn and rye. Here are the articles which will appear in the

February Mid-month Magazine Number:

¶ **The Science of Fertilizing the Soil,** by Mr. Walter Henry Beal, of the Office of Experiment Stations, U. S. Department of Agriculture.

THE chemist, as Mr. Beal will tell you, has taught the farmer how to fertilize the soil scientifically. He has taught him that fertilizing is not merely a matter of spreading manure and phosphate, but a chemical task just as important as that which involves the manufacture of the thousand and one drugs in a chemist's shop. Mr. Beal will show how the farmer nowadays takes a tiny composite sample of his earth, puts it through the processes of chemical and physical analysis, so that he may ascertain whether or not he is planting what he ought to plant in order to obtain the best results, and whether his soil contains too much or too little alkaline matter instead of valuable humus.

¶ **Breeding New Grains, Plants and Flowers,** by Prof. W. J. Spillman, Agriculturist in Charge of Farm Management Investigations, Bureau of Plant Industry, U. S. Department of Agriculture.

SUPPOSE that you found yourself in a country climatically so constituted that the ordinary grain could not be grown profitably in it. Suppose, in other words, that the ordinary grain had to be changed to withstand greater colds or some strange disease. Fifty years ago that tract of land would have been a desert. To-day it blossoms with a crop of its own, a crop which is not of nature's creation, but of man's. Prof. Spillman will tell you how all this has been brought about. He will show how the plant breeder creates in his mind a certain wheat, or rye, or corn, a thing that exists nowhere on the earth exactly as he conceives it, but which must exist if that particular piece of land is to be made a profitable farming country. He will show how quality of this plant is blended with some quality of that plant, how the new plant which combines these qualities is again combined with a third plant, and how at last, after years of work, the new variety is obtained which realizes the conception which the plant breeder originally formed. Surely such work has its romantic side. The mere facts in themselves speak volumes. How the plant breeder goes to work, how failure after failure meets him, how he plods on undaunted, and finally arrives at the realization of his plant dream, all this Prof. Spillman will tell, as only he can tell it.

¶ **The Science of the Soil,** by Mr. Walter Henry Beal, Office of Experiment Stations, U. S. Department of Agriculture.

DO you know that some soils are sick? That they must be cured just as if they were living, human beings? Did you know that they are infected sometimes with harmful bacteria, that they grow tired, that they need a rest? In a word, did you know that the soil, so far from being an inert mass, is as sensitive chemically and physically as an animal? Mr. Beal will point all these things out to you and show what the work of the modern chemist has done in discovering the diseases of soils, in curing these diseases by the proper addition of the missing chemical elements or the destruction of harmful bacteria, and how worn-out soils are reclaimed and made to produce crops again.

¶ **Cement on the Farm,** by Ralph C. Davison.

THE old wooden fence post and silo have given place to the more substantial concrete structure. Mr. Davison is a practical man who has worked with concrete for years, a man who has seen concrete take its place in almost every form of building. He will describe what the possibilities of concrete are on the farm, by holding up to you its successful use for almost every purpose for which wood was formerly used. What is more, he will drive home the immense pecuniary advantages of using the newer material—its comparative cheapness in regions where lumber is scarce, its durability, and all those other qualities which have made concrete an ideal building material.

¶ **New Reaping and Binding Machinery.**

HERE we will discuss the mechanics of agriculture, the use of the traction engine instead of horses, as the motive power of farming implements; the reapers that cut a swath of 20 to 26 feet as the engine proceeds; the gathering of the fall by automatic rakes; the threshing and sacking of wheat by machines; the planting of corn by special drills which have taken the place of the old method of hand dropping; the combination of cutter and binder which in one hour does the work formerly requiring a day for one man to perform with the old corn knife; machines which have displaced the husking peg and shell corn at the rate of a barrel a minute; and the rakes and stackers that cut a ton of hay in one hour and a half, work that once required eleven hours for one man.

¶ **The Motor and the Dynamo on the Farm.**

EVEN the electrical and mechanical engineer have done their share in uplifting the farmer. Dynamos of special type have been invented to light and heat the farm house. They generate a current which will drive electric motors that will do most of the work formerly performed by hand. Gasoline engines are employed for pumping, and for driving machinery of various kinds. In a word, the motor has, to a large extent, taken the place of the human arm. The mechanical cream separator and churner do the work of ten men at perhaps one-tenth the cost. All these mechanical improvements have converted the farm house and its outlying buildings into dwellings that are as comfortable and livable as any well-appointed country house.

Mid-month Magazine Numbers for 1911.

THE February Mid-month Magazine Number is but the beginning of a whole series. We are inaugurating a new "Scientific American" which will be bigger and broader than the "Scientific American" has been in the past. Each month we will issue a magazine number in which, besides the regular pages of the "Scientific American," the reader will find articles by eminent men on important scientific or mechanical topics. The Mid-month Number for February, for example, in which the scientific aspects of modern agriculture will be simply discussed, will contain not only the articles enumerated in the foregoing list, but also the regular pages of the "Scientific American" in which the achievements of eminent chemists, astronomers and engineers are recorded as usual. Following this plan other Mid-month Magazine Numbers will give, in addition to the regular matter, special articles on the following topics:

JANUARY—The Annual Automobile Number.

FEBRUARY—The New Agriculture.

MARCH—Cement.
The most notable factor in engineering and architecture to-day is the rapidly extending use of concrete. It is the chief material in the Panama Canal, irrigation, dams; is being used for posts, telegraph poles, piling, and even for ships.

APRIL—Light and Heat.
Interior and exterior illumination. Electric, gas, acetylene lamps; economical lighting, electric flashing signs, street lighting, etc.

MAY—Aviation.
This number, while chronicling the flying events of the year, will give particular attention to the dirigible; it will have an article on Brucker's attempt to cross the Atlantic from East to West, in which his dirigible will be fully illustrated and described. Progress with dirigibles in Germany, France, and England will be made clear.

JUNE—The Railroads of a Continent.
The new Trans-Canada Railway; map showing all transcontinental roads. Brief description of each road, length, number of engines, cars, etc., passengers and freight carried. Photographs and diagrams of locomotives, etc., block signals, switches, etc.

JULY—The Merchant Marine.
We once led the world—we are now the last. Illustrations of the fast packet sailing ships of the 50's and the tea clippers. How the Civil War, etc., killed our merchant marine. Need of subsidy to revive shipping. Illustrations of giant liners—all foreign owned.

AUGUST—Conservation.
Comprehensive scheme for conserving the flood waters and delivering them through canals to the arid lands. Map showing all projects, present state of work and work to be done. How huge dams have been built, canals cut, tunnels driven, deserts turned into unbelievably productive farms and thriving cities builded. Statistics of the original and the present size of our forests; means for preventing loss by ruthless cutting, and by fire.

SEPTEMBER—Aviation.
This number will contain illustrations of all the notable improvements of the year in dirigibles and aeroplanes. Detailed drawings will show constructional features, photographs of machines finished and in flight. There will be special articles by the men who have made flying possible.

OCTOBER—The United States Navy.
Article on the great improvement in gunnery in the U. S. Navy by an officer who has had most to do with it; showing why and by how much we lead the world. Profusely illustrated with views of each class of ship, from the torpedo boat and submarine up to the 26,000-ton dreadnought "Wyoming." Article on the construction of a battleship, laying the keel, erecting the frames, plating, putting on the armor, mounting the guns, and erecting the engines and boilers.

NOVEMBER—Industrial Chemistry.
Synthetic chemistry, coal tar products, artificial production of rubber, etc. Metallurgy, chemistry of steel and various alloys. Electrochemistry works at at Niagara. Describing various processes.

DECEMBER—To be announced.

The programme which we here outline is subject to change. We may decide to modify in some respects the order in which the topics are to appear.

RETROSPECT OF THE YEAR 1910.

(Continued from page 519.)

ence for the direct current system for use on suburban and terminal lines. At a meeting of the American Society of Mechanical Engineers, George Westinghouse made a strong plea for uniformity in the future electrification of railroads. This is a problem which calls for an early solution, if our railroads are not ultimately to be confronted with the same costly and inconvenient complication that arose from the diversity of gages in the early history of steam railroads.

More encouraging than the New Haven report is the announcement of the results of operation of the St. Clair tunnel, where the change from steam to electricity has resulted in a reduction of 39 per cent in fuel consumption, 40 per cent in general operating expenses, and a total reduction of 20 per cent as compared with operation by steam locomotives. Reports from abroad, notably from Great Britain, as to the results of electrification of steam railroads, are distinctly encouraging. The electrification of the Mersey Railway has raised the average speed from 15.6 to 19.9 miles per hour; the number of ton miles per year has gone up from 43 to 67 millions, and the total expenses per ton mile, including the interest on capital cost, have been reduced from 0.344 to 0.293 of a penny. The results obtained on the Northeastern Railway and the Midland Railway from electrification show similar improvements, both in economy and in improvement of operation. Considerable interest has been aroused by the construction of a turbo-electric locomotive which is being tested on the Caledonian and North British railways in Europe. The current for driving the motors is generated by a dynamo which is direct connected to a turbine engine. Steam is supplied by an ordinary locomotive type boiler, fitted with a superheater. The exhaust steam passes to a condenser, and the condenser water passes thence to a hot-well, from which it is returned to the boiler by means of a feed pump. The place of the steam exhaust is taken by a small turbine-driven fan. The turbine runs at 300 revolutions, and current is supplied at from 200 to 600 volts pressure to the four series-wound traction motors on four main driving axles. This is a revival of the French Heilmann steam electric locomotive of a dozen years ago, with the difference that the Heilmann locomotive used reciprocating engines, and that various refinements have been introduced into the present machine. At the present writing, the results of the tests, which are still in progress, have not been made public. Some of the most important developments in the electrical world are those in the feld of hydraulic-electric engineering. The question of the further diversion of water at Niagara Falls for power purposes was settled during the year by the signing of a treaty between the United States and Great Britain regulating this important question. According to the provisions, the New York side will be permitted to take 20,000 cubic feet from the river above the falls, and the Canadian side may divert 36,000 cubic feet. The treaty contains a provision allowing the Canadian company to transmit and sell on the United States side at least 50 per cent of the power generated in Canada. The trend of hydraulic electric practice is in the direction of generators and turbines of unprecedented dimensions, the latest installation, on the White River, near Tacoma, being designed to include water turbines each developing 20,400 horsepower under a maximum head of 480 feet. After nine years of experimental work, Edison appears to have brought his storage battery up to the point at which it is ready for commercial exploitation. A street railway car, equipped with the new battery, has been running successfully on one of the crosstown lines in this city, and has proved its economy for such service over other types of cars which require trolley transmission, either overhead or underground. The subject of illuminating engineering is occupying a great deal of attention at present. This new branch of electrical engineering received an impetus at the recent convention in Baltimore, which was followed by a two weeks' course of lectures at Johns Hopkins University, taking up all the phases of illumination. These lectures were attended by numbers beyond expectation; which speaks well for the future development of electric and other types of illumination. In this connection, the invention of Dr. Peter Cooper Hewitt, by which the rays lacking in mercury vapor lamps may be supplied, is important. He has provided a reflector coated with a fluorescent material by which waves of light have their frequency altered and are reflected as waves of a greater length. Thus certain of the rays are transformed into red rays by the reflecting material and a close approximation to daylight is obtained.

THE EXPLOSION AT THE GRAND CENTRAL TERMINAL.

(Continued from page 521.)

main leading from the storage tanks to the various supply pipes throughout the yards. But three of the four tanks were filled with gas, and this escaped rapidly from the broken main. Despite the fact that the pungent gas produced a pronounced odor in the neighborhood within a quarter of an hour, and also that the man in charge of the gas tanks noticed the pressure was falling, and finally shut one of the valves, a sufficient quantity of gas escaped and mixed with the air beneath the power house to make an exceedingly explosive mixture. Suddenly, twenty-nine minutes after the accident, and while men were at work trying to jack the car back on the rails, there was a terrific explosion that shattered window glass for blocks around, besides committing great devastation in other ways. A trolley car that was passing Fiftieth Street on Lexington Avenue was overturned on top of a passing automobile. Four passengers in the car were killed outright, and many others were seriously injured. By a miracle the chauffeur of the automobile (who was the sole occupant) escaped without serious injury. The greatest force of the explosion seems to have been toward the east. It wrecked the power house rather badly, blowing off the roof, as shown in our photographs; but with this exception no very serious damage was done to buildings in the immediate vicinity, save for the breaking of window glass. The explosion spent its force through the yards toward the west, and buildings on Madison Avenue did not suffer damage, as a rule. A bricklayer, who was working on a tall chimney of the power house, was lifted from his scaffold and dropped into a flue; he was not seriously injured and was able to give a good account of the entire affair from the time the train ran away to the moment of the explosion.

This accident has demonstrated the danger of gas for the lighting of railway trains, and it is to be hoped that our leading railroads will abolish its use and substitute electricity from storage batteries where it is not possible to use current from the feed wires. In the case of local trains on both the New York Central and the New York, New Haven and Hartford lines, electricity can readily be used (and is used on the former system); but on through trains it is necessary to install a storage battery plant on each car or else use some form of gas illumination. The Pintsch gas has been used for a number of years satisfactorily, but how dangerous it is under certain conditions has been demonstrated at last very forcibly. In the case of a railway accident cars that are lighted by gas can readily catch fire, while the storage

(Concluded on page 531.)

INDEX.

The * Indicates that the Article is Illustrated with Engravings.

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance. Further information sent on request.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry **may** be repeated.

MUNN & CO., Inc.

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I WILL START YOU IN THE MIRROR BUSINESS Best paying trade of to-day. Famous French method. $5 to $12 daily. Let me prove it. Free particulars. Corey, Dept. 32, Omaha, Neb.

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FOR SALE.

Inquiry No. 9188.—Wanted, manufacturers of rubber block tires for one ton trucks.

FOR SALE.—An emergency brake for street cars. Can be used over any style track. Patent allowed Nov. 26, 1910. Will sell outright or on royalty, royalty preferred. Fred Wirsing, 30 East 5th Street, Newport, Ky.

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HELP WANTED.

Inquiry No. 9207.—Wanted, names and addresses of firms making star section iron and steel suitable for lightning rods.

GET A BETTER PLACE—Uncle Sam is best employer; pay is high and sure; hours short; places permanent; promotions regular; vacations with pay; thousands of vacancies every month; all kinds of pleasant work everywhere; no lay-offs; no pull needed; common education sufficient. Ask for free Booklet 40, giving full particulars and explaining my offer of position or money back. Earl Hopkins, Washington, D. C.

Inquiry No. 9208.—Wanted, the address of the manufacturer of the "Little Giant" Pump

WANTED.

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WANTED.—January 1st next experienced traveling man to represent the very best Vacuum Cleaner on the market. Portable, Semi-Portable and Stationary. Victor Cleaner Company, York, Pa.

Inquiry No. 9210.—Wanted, names of owners of deposits of pumice or volcanic ash.

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COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., Inc., List Department, Box 773, New York.

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A LIST OF 1,500 mining and consulting engineers on cards. A very valuable list for circularizing, etc. Price $15.00. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9214.—Wanted, address of maker of "Piako," a fastening for ladies' dresses.

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Inquiry No. 9218.—Wanted, the names and addresses of manufacturers of outfits for salting almonds and peanuts.

Inquiry No. 9219.—Wanted, names and addresses of manufacturers of bags, cartons, and oiled and waxed paper for marketing salted almonds and peanuts.

Inquiry No. 9220.—Wanted, the names and addresses of manufacturers of plants for the preparation and mixing of baking powders; also dealers in ingredients for making the powder, manufacturers of cans, labels, etc., for packing baking powder for the market.

Inquiry No. 9221.—Wanted, names and addresses of owners of mica properties.

Inquiry No. 9222.—Wanted, names and addresses of owners of white silica sand deposits.

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Inquiry No. 9227.—Wanted, a power-driven saw for cutting down pine trees twenty inches in diameter.

Inquiry No. 9228.—Wanted, to buy fabric tufting machines.

Inquiry No. 9229.—Wanted, addresses of manufacturers of an alloy called Duraluminum.

(Concluded from page 528.)

tank offers another source of danger. With the several successful systems of lighting by electricity by means of batteries charged with a dynamo driven from the car axle, or by a turbine-driven dynamo on the locomotive, there should be no trouble in having all trains electrically illuminated. To avoid the use of a separate battery on each car, the cars can be connected together by suitable cables and the lamps fed from a single battery plant carried on the baggage car.

While the exact cause of the explosion at the Grand Central Terminal may never be known, it undoubtedly resulted from the ignition of an explosive mixture of gas and air by an electric spark. Electricity and gas are dangerous agents to use side by side, and where the former is made use of for power purposes the latter should by all means be abolished for the purpose of illumination.

Hydrocarbon Gas by Vacuum Process.

(Concluded from page 522.)

rarily creates a vacuum therein, until a new supply of air and gasoline can be inspired. A measured quantity of atmospheric air and gasoline rushes to fill this rarefied space.

By taking gasoline from the bottom to the top of the supply tank, each little bucket will contain its heavier and lighter parts, mixed uniformly in minute quantities, so that the quality of the gasoline is always the same. By any other means of carbureting or supplying gasoline, rapid deterioration sets in.

The machine has a feeding device, which can be so regulated as to produce 10 grains or 300 grains of gasoline into a cubic foot of air, should so much be desirable for any reason.

The Overestimated Antiseptic Power of Vinegar.

Vinegar is still regarded as indispensable in every household, but it was far more highly esteemed centuries ago. The alchemist valued it as the most easily obtained acid and the physician employed it to reduce fever and to destroy foul odors. At one time vinegar, though it was by no means cheap, was used in washing floors and disinfecting privies, for it was regarded as a powerful antiseptic. Experience had taught that wine and beer cease fermenting when they have turned sour, and that meat can be kept in vinegar for a long time. Hence physicians who visited patients stricken with the pest placed cloths or sponges wet with vinegar over their nostrils, and vinegar was evaporated in the sick rooms and employed in a vain attempt to destroy the foul stenches which filled the air in the Middle Ages. This faith in the disinfecting power of vinegar is not yet quite dead, and it was so much alive one hundred and thirty years ago that in the year 1782 two learned bodies in Paris, the Royal Academy of Sciences and the Academy of Medicine, at the instigation of the French government, took gravely into consideration a process proposed by one Lanin for banishing the odors and dangers of cesspools by the introduction and evaporation of vinegar. At a time when neither bacteriology nor chemistry existed, the only possible way of testing the value of the process was by practical experiment. For this purpose a pit was selected which had defied an attempt to clean it eight months previously. The committee appointed to conduct the experiment devoted an entire day to evaporating vinegar in a cellar into which the pit opened. After the stench had been somewhat mitigated by this means and "twenty-seven basketfuls had been drawn up," a workman was lowered into the pit. When he was hauled up he asserted that he suffered no inconvenience, but the second man to try the experiment swooned and could not be restored to consciousness, and several others fainted in the attempt to rescue him, but recovered.